University of Alberta

A Comparison of Three Knowledge Approaches to Teaching Skill Analysis To Pre-Service Elementary Generalist Teachers

by

Nora Ruth Way ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

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The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "A Comparison Of Three Knowledge Approaches To Teaching Skill Analysis To Pre-Service Elementary Generalist Teachers" submitted by Nora Ruth Way in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Abstract

Shulman (1987) has identified teacher knowledge as including both content and general pedagogical knowledge plus pedagogical content knowledge, which he defines as the blending of pedagogical processes which apply to specific content areas. The incorporation of pedagogical content knowledge approaches to teacher education has been examined in many research studies in recent years. The majority of these have focused on the development of pedagogical content knowledge through educational fieldwork experiences or as novice teachers. The purpose of this study was to compare three approaches to teaching skill analysis of two fundamental motor skills (standing long jump and overarm throw) to pre-service teachers within an elementary education physical education subject specific course. The three treatments were designed to represent a general pedagogical knowledge approach, content knowledge approach, or pedagogical content knowledge approach to teaching skill analysis. The subjects were 100 pre-service elementary school generalist teachers at the University of Alberta. Three intact classes were administered one of the treatments while the fourth acted as a control group for the study. Equivalent time was allocated for each of the treatments. ANOVA's were used to compare the change in score from pre- to post-test on three variables for each skill. The scores were based on: a) written test of knowledge of developmental components for each skill; b) statements describing the skill as observed from videotaped performances by four children; c) statements of feedback to assist the children observed in improving their skill performance. The results showed no change in the variables measured for the

pedagogical knowledge treatment group nor the control group. The content knowledge and pedagogical content knowledge treatment groups showed significant ($p<.05$) improvement on all variables form the pre-test to the post-test. The pedagogical content knowledge group was also significantly ($p<.05$) better in the feedback statements for the jump than the content knowledge group on the post-test. The results of this study demonstrate that a specific (in this case physical education) course topic can be taught effectively in the same time frame using a pedagogical content knowledge approach as teaching tne content component only. This study did not address whether this approach to teaching content resulted in creating an advantage for the pre-service teacher in the development of pedagogical content knowledge when placed in a field work setting.

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CHAPTER 1

INTRODUCTION

The science of teaching, known as pedagogy, and the training and education considered necessary to prepare persons to teach, have been subject to extensive research and study throughout the last century. For many years, research on teaching had focused on pedagogy, including "how teachers manage their classrooms, organize activities, allocate time and turns, structure assignments, ascribe praise and blame, formulate the levels of questions, plan lessons, and judge general student understanding" (Shulman, 1986, p. 8). When content or the subject was examined it was "from the perspective of the learner" (Shulman, 1986, p. 8). Within the last decade, research questions have concentrated more on how the content of the lessons was being taught with regard to the teacher's expertise in a subject area, and how that knowledge is related and presented to the students. From this perspective, it appears that the process of teaching had been of greater concern to researchers than what had been taught. Shulman (1986) notes that the "distinction" between subject knowledge and pedagogy in research is, in our time, a relatively new development and that the emphasis on pedagogy has created a "missing paradigm" in educational research. Subject knowledge has largely been ignored in research on teaching and, as a result, has also been de-emphasized in teacher certification and evaluation.

Shulman (1986) proposed that teacher knowledge be placed in several categories: content knowledge, curriculum knowledge, and pedagogical content knowledge. Content knowledge refers to the quantity and organization of the knowledge a teacher has in a given subject. Within the realm of content knowledge, the teacher must not only know the facts of the discipline but also be able to explain why particular topics are worth knowing and how they relate to other topics within and without that discipline. Curriculum knowledge incorporates understanding of methods or programs for teaching particular subjects and topics, as well as the variety of instructional materials and the techniques of use which can be applied to teach a specific subject (e.g., video-tapes, films, books, discussion groups, etc.). Pedagogical content knowledge encompasses a combination of content and pedagogy; that is to say, the aspects of the content relevant to its teachability. Included in this dimension is "what makes the learning of a specific topic easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons" (p. 9), identifying the importance of the teacher "knowing" the learner.

In his article "Knowledge and Teaching: Foundations of the New Reform", Shulman (1987) expanded on the roles of content and pedagogical content knowledge. These variables of teaching are difficult to assess through standardized tests and are often "ignored in the quest for general principles of effective teaching" (p. 6). Shulman advocates the combination of content and pedagogy in teacher education and evaluation. In this scenario, he identifies pedagogical knowledge as another type of knowledge comprising the "broad principles and strategies of classroom management and organization that appear to transcend subject matter" (p. 8) In this article curricular knowledge is absorbed into pedagogical knowledge. He theorizes that the amalgamation of content and pedagogy would produce "a special form of professional understanding" (p. 8) which clearly "distinguishes the understanding of the content specialist from that of the pedagogue" (p. 8). Shulman stipulates that "the knowledge base must therefore deal with the purposes of education as well as the methods and strategies of educating" (p. 13).

Shulman's approach to teacher education is heavily cited in literature (Carpenter & Peterson, 1988; Cochran, King, & DeRuiter, 1991; Fortin, 1993; Griffen, Dodds, & Rovegno, 1997; Henderson, 1988; Housner, 1992; Housner, Gomez & Griffey, 1993a, 1993b; Metzler, 1991; Peterson, 1988; Schoenfeld, 1988; Sockett, 1987; Vickers, 1990). His concept of teacher knowledge has also been applied in educational research examining a variety of subject areas such as English, Mathematics, and Physical Education (Barrett & Collie, 1996; Carpenter, Fennema, Peterson, & Carey, 1988; Grossman, 1989, 1990; Leinhardt & Smith, 1985; Peterson, Fennema, Carpenter, & Loef, 1989; Rovegno, 1993, 1994; Walkwitz & Lee, 1992a).

In one of the few investigations focusing on physical activity instruction, Walkwitz and Lee (1992a) attempted to "gain insight into the nature of pedagogical content knowledge in physical education" (p. 179). The study focused on the subject knowledge of eight kindergarten teachers with respect to the overhand throw and how this knowledge translated into classroom events. The results revealed that the level of knowledge of the subject matter and pedagogical content knowledge made a difference in the interpretations of observations made by the teachers and were also reflected in student motor patterns when taught by those teachers, especially in the stepping action. Fortin (1993) also suggested that although "the technical content knowledge acquired as a dancer is indeed necessary, [it is] yet insufficient for quality teaching ..." (p. 38). She hypothesized that Shulman's concept of pedagogical content knowledge may provide the direction for transforming dancers into dance teachers.

The majority of pedagogical content knowledge studies have focused on comparison of novice and experienced teachers, or on development of pedagogical content knowledge by student teachers. The studies to date have indicated the importance in the use of pedagogical content knowledge by teachers in translating subject material into classroom lessons. The effective teachers were able to combine the content and pedagogy into a form that was influential in organizing, and adapting the material for the diverse abilities of their learners. These studies have also indicated that there is a need to provide more than content knowledge and pedagogical knowledge as separate dimensions during teacher education. Pedagogical content knowledge, a meshing of the subject matter and pedagogical processes, must be included in subject-specific teacher education to provide future teachers with an understanding of how to transform the subject material into a form that their students can learn.

Elementary school physical education could incorporate the theoretical framework of pedagogical content knowledge in teacher education. One of the most important objectives of elementary school physical education is the development of fundamental motor skills (Alberta Education, 1983; Gallahue, 1987, 1993; Graham, Holt-Hale, & Parker, 1993; Haubenstricker & Seefeldt, 1986; Kirchner, 1992; Wall & Murray, 1994). The National Association for Sport and Physical Education (NASPE), in their position statement (1993), identified "...expertise in the special areas of fundamental motor skills...founded upon an understanding of pedagogical physical education and the appropriate disciplinary knowledge ..." (p. iv) as an essential component for teachers of physical education.

When children begin elementary school, they bring with them a repertoire of fundamental motor skills that appear in many forms (Gallahue, 1982, 1987; Gallahue & Ozmun, 1995; Haywood, 1993; Haubenstricker & Seefeldt, 1986; McClenaghan & Gallahue, 1978; Payne & Isaacs, 1995; Roberton & Halverson, 1984; Wickstrom, 1983). Motor development theories have identified that a child's development of these abilities has been influenced by his/her individual heredity, environment and experiences. These theories include, for example, information processing, dynamical systems perspectives, and the more traditional theory of maturation. Maturation theory has developed and examined descriptions of sequences which motor skills appear, and these sequences have been and remain prominent in elementary physical education and motor development literature (Gabbard, LeBlanc, & Lowy, 1994; Gallahue, 1982, 1987; Gallahue & Ozmun, 1995; Haywood, 1993; Haubenstricker & Seefeldt, 1986; McClenaghan & Gallahue, 1978; Pangrazi & Dauer, 1995; Payne & Isaacs, 1995; Roberton & Halverson, 1984; Wickstrom, 1983). Although motor development theorists have different beliefs in the value of the various theories, the maturation theory and developmental sequences approaches provide useful information to incorporate into the assessment of a child's movement capabilities on a comparative basis. The fundamental motor skills identified through maturation theory have been recognized as the basis for the acquisition of higher level physical activity and sport skills (Espenschade & Eckert, 1967; Gallahue, 1993; Gallahue & Ozmun, 1995; Haubenstricker & Seefeldt, 1986; McClenaghan & Gallahue, 1978, Roberton & Halverson, 1984; Wickstrom, 1983). Therefore, the achievement of efficient or mature fundamental motor skills may be a major contributor to providing the child with a level of competence needed to pursue a healthy, active lifestyle.

There is consensus among authors that the run, throw, catch, kick, strike, and jump are fundamental patterns, although some authors categorize additional skills as fundamental (e.g., skip, gallop, leap, hop). Maturation based motor development specialists also agree that there is a relatively predictable sequence through which most children progress to attain mechanically efficient motor movement in fundamental motor skills, referred to as a mature motor pattern (Espenschade & Eckert, 1982; Gallahue, 1993; Haywood, 1993; McClenaghan & Gallahue, 1978, Roberton & Halverson, 1984; Wickstrom, 1983). Although there are some differences in the specifics of defined sequence components, there are many more similarities. Authors include the same phases (e.g., preparation of the arm for an overarm throw) but sometimes describe them slightly differently. There are also indications that a child may exhibit a different level of development in the action of one body part from that of another, although the difference will usually be identified by the adjacent levels (Roberton, 1978; Roberton & Halverson, 1984; Roberton, Halverson, Langendorfer, & Williams, 1979). For example, when performing an overhand throw, a child may demonstrate an advanced leg action, but the pelvis and thorax of the body still rotate as a block, which is a less advanced component of the throwing pattern (Roberton & Halverson, 1984). Unfortunately, the empirical evidence to support the validity and reliability of the developmental sequences is extremely limited, due to the requirement of longitudinal study. One exception to this is the component model of trunk-action and arm-action of the overarm throw as described by Roberton and Halverson (1984) which was validated through longitudinal research (Roberton, 1978; Roberton, Halverson, Langendorfer, & Williams, 1979).

Motor development research indicates that 60% of children will progress in most fundamental motor skills to a mature pattern by the age of seven years (Seefeldt & Haubenstricker, 1982). Development and refinement of fundamental motor skills will usually continue to at least the age of 10 years. It has also been recognized by many motor development specialists and researchers that some children and adults may never attain an efficient motor pattern in all fundamental patterns (McClenaghan & Gallahue, 1978; Roberton & Halverson, 1984; Seefeldt & Haubenstricker, 1982; Wickstrom, 1983). If, however, children are provided with a well structured physical education program, taught by a teacher knowledgeable in skill development, they have the opportunity to become skilled in the fundamental motor skills. The elementary school teacher of physical education, whether a specialist or a generalist, should have a sound knowledge of the development of fundamental motor skills, plus the pedagogical ability to observe skill performance, provide corrective feedback, and assist each child in acquiring effective and efficient fundamental motor skills through developmentally appropriate activities. The motor development models, although not fully validated, provide realistic, current and valuable content knowledge from which teachers can derive the information they need for the provision of augmented feedback to guide a child in developing advanced movement in fundamental motor skills.

Many programs in physical education are designed to provide the opportunities for children to practice the skills in a variety of activities and environments, so that development can occur while preparing to learn higher level skills required in games and sports. With the variation in entry level abilities of children in performing fundamental motor skills, teachers must be prepared to observe the performance of the skills and qualitatively analyze the developmental level of each child. Haywood (1993) suggests that teachers can use the information provided in developmental sequence descriptions of maturation research to guide children to improve in the performance of these basic skills. The teacher can then intervene by manipulating practice opportunities, altering goals, or providing augmented feedback which will assist the child in progressing up the developmental ladder toward a more advanced pattern. This process of combining knowledge of movement with pedagogical processes of observation and feedback for the specific goal of the single learner would be identified as an aspect of pedagogical content knowledge. If teachers can be educated to assess accurately and provide useful, correct and timely feedback to assist children in the development of motor skills, more children should develop greater ability to perform fundamental motor skills than is otherwise the norm. Interpreting Shulman (1987), the teacher must possess the pedagogical skills of effective observation and provision of feedback, and must acquire the content knowledge concerning the developmental sequences of fundamental motor skills in order to accomplish this task effectively. Furthermore, the teacher should be able to combine and employ these knowledge components (pedagogical and content) effectively in providing the optimal learning scenario for a given child.

The studies examining pedagogical content knowledge have not identified the extent to which this knowledge component can be taught in teacher education courses or whether it can be gained only through experience when student teaching or following formal education. Since much of elementary physical education is taught by generalist teachers, the question arises: Can generalist teachers, responsible for instructing physical education classes in elementary schools, effectively learn the pedagogical content knowledge? Since these teachers require a diverse education, a second question also becomes apparent: Can the necessary knowledge be gained in a time frame which is allocated to physical education pre-service instruction?

Purpose

The purpose of this study was to design and compare the effectiveness of three programs of teaching skill analysis of two fundamental motor skills to pre-service elementary school generalist teachers. The three programs were based on Shulman's (1986) concepts of pedagogical content knowledge, content knowledge, and pedagogical knowledge. The effects of each instructional program compared the elementary education pre-service teachers' knowledge of developmental sequences, ability to observe, and ability to provide feedback on the throw and jump.

Limitations

The limitations within this study involved the use of the component model of developmental sequences for the fundamental motor skills of the standing long jump and forceful overarm throw as defined by Roberton and Halverson (1984). Additional resources and descriptions of developmental sequences were incorporated from other sources (Gallahue, 1982; Seefeldt & Haubenstriker, 1982). These sources provided the content knowledge component for the study.

The study was also limited to the use of the "Hypothetical Model of Observation" (Barrett, 1983) and description of "Pedagogical Kinesiology" (Hoffman, 1977) as the sources for pedagogical knowledge.

The analysis to compare groups was limited to the change in scores from the pre-test to post-test, which limited the amount of possible difference between groups.

Delimitations

The study was delimited by the quasi-experimental design using intact classes of subjects, where the classes were randomly assigned to treatments or control. This reduced the generalizability of the results. Also, the focus of this study was to deliver the treatments within a teacher education classroom/gymnasium environment and not to include practical application of the treatment in a practicum setting. Therefore, the results are generalizable to an elementary physical education pre-service teachers' classroom setting only.

Definitions

The following definitions were consistently used within this report unless otherwise stated:

Throw - the performance of a forceful, unilateral, overarm throwing pattern.

Jump - a standing long jump for distance.

Content Knowledge (CK) - the knowledge of developmental sequences. Specifically in this study the throw and jump were the focus, as reflected by the performance score on the written knowledge test described in Chapter 3.

Pedagogical Knowledge (PK) - the knowledge of provision of feedback and observation in a physical activity setting as defined by Hoffman (1982) and Barrett (1983), respectively.

Pedagogical Content Knowledge - the knowledge gained in the integrated teaching process which combines knowledge of developmental motor sequences of the throw and jump with knowledge of provision of feedback and observation in a physical activity setting as they apply to the throw and jump. The ultimate measure of this knowledge will be based on the feedback test described in Chapter 3. Pedagogical Content Knowledge in this study did not encompass the interaction with the student and the student response to the feedback created by the subjects.

Skill Analysis – the ability to accurately observe and assess the performance of two skills (standing long jump and overarm throw for force).

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this chapter is to present and discuss literature that is pertinent to the study in question. Areas reviewed include: studies incorporating the application of pedagogical content knowledge, the importance of the development of fundamental motor skills for children, the role that physical education instructors play in the development of fundamental motor skills, the function of observation and skill analysis in the provision of feedback to those learning motor skills. In order to deal most effectively with the variety of subject areas, the review of literature has been subdivided into three distinct sections. First, the area of pedagogical content knowledge will be addressed, followed by content knowledge pertinent to the development of fundamental motor skills. Finally, pedagogical knowledge related to skill analysis in physical activity will be reviewed.

Pedagogical Content Knowledge

Pedagogical content knowledge, as defined by Shulman (1987), is the integration of subject knowledge and pedagogical processes that relate to that subject. The knowledge base must incorporate the purposes of education with "the methods and strategies of teaching" (p. 13). Many of the studies examining pedagogical content knowledge have evaluated experienced teachers and their knowledge development. Leinhardt and Smith (1985), although not directly testing Shulman's theoretical framework, examined the relationship between novice and expert teachers' classroom behavior and their knowledge of fractions (content knowledge) in mathematics. They also investigated the methods by which expert teachers applied their knowledge. They identified that the lessons progressed in similar sequences for both categories of teachers. Expert teachers had variable knowledge levels of fundamental fraction concepts, while the novice teachers generally demonstrated low knowledge levels. The experts sorted mathematical problems using more elaborate categories and sub categories than the novices, which indicated an application of pedagogical knowledge specific to mathematics. This study indicated that although expert teachers may have personal differences in content knowledge, their pedagogical knowledge was similar, as demonstrated in their classroom instruction. It was noted that "as teachers increase their conceptual knowledge and become more fluid in connecting their knowledge to lesson presentations, their students' mathematical competence should improve" (p. 270). The connection between the knowledge and presentation, as the expert teachers possessed, would comprise their pedagogical content knowledge.

Gudmundsdottir and Shulman (1987), through observation and interviews, found that an experienced social studies teacher was more flexible in selecting the method to teach different topics than an inexperienced social studies teacher. Their findings implied that pedagogical content knowledge in teacher education, and inservice training would enhance the teachers' abilities to provide flexibility in selecting the appropriate methods to teach students a variety of topics.

Grossman (1989,1990) found similar results when studying the role of pedagogical content knowledge in English, among first year secondary school

English teachers. Through the comparison of case studies, Grossman ascertained that subject-specific teacher education (pedagogical content knowledge) directs teachers to construct concepts of the meaning of teaching a subject, and to identify what learners do and do not understand about specific topics within the subject. By examining their conceptions, the teachers were able to provide the students with an effective learning opportunity; that is, the subject matter was structured with the learners' abilities and tendencies in mind.

Carpenter, Fennema, Peterson, and Carey (1988) investigated the pedagogical content knowledge demonstrated by 40 teachers of grade one when teaching children to solve addition and subtraction word problems. Through written assessments and video-tapes of children completing mathematics problems, the teachers were tested on their knowledge of problem types, problem solving strategies used by children, and prediction of student performances. "Most of the teachers in this study were reasonably successful in identifying many of the critical distinctions between problems and the primary strategies that children use in solving addition and subtraction problems" (p. 398). The knowledge demonstrated by the teachers was not organized in a manner which would allow them to relate the nature of problems, the level of problem difficulty, and the children's solutions to one another. Student achievement showed moderate, but significant, positive correlation to the teachers' knowledge of their own students' abilities to solve problems. The study provided support for the need of subject-specific (content) teacher education in problem solving for elementary arithmetic and the interaction with that knowledge to student needs and levels of understanding which are components of pedagogical content knowledge.

Pedagogical content knowledge, in combining content knowledge and pedagogy, includes the prejudices or biases that teachers may have regarding their students. Peterson, Fennema, Carpenter, and Loef (1989) classified these preconceived notions teachers have of students as pedagogical content beliefs, and developed a conceptual framework to examine these beliefs as they related to the teaching of mathematics (addition and subtraction) by first grade teachers. The pedagogical content beliefs focused on certain assumptions teachers had about how children learn mathematics. Within this framework, they attempted to link the pedagogical content beliefs of a teacher to the teacher's pedagogical content knowledge. They concluded that, although pedagogical content beliefs differ among teachers, they are related to pedagogical content knowledge. It was also shown that the beliefs of the teachers influenced the method of instruction, content focus and goals used. This supports Shulman's contention that pedagogical content knowledge links subject-specific content with characteristics of the learners so the teacher may effectively deliver the material. In this case the characteristics of the learners are observed through the biases of the teacher and how those biases may influence or direct the teaching of the material.

A further study by Gudmundsdottir (1990) demonstrated that teachers' values influenced the way they restructured their content knowledge to create pedagogical content knowledge. This area needs to be addressed in order to provide prospective teachers with the additional pedagogical content knowledge and an insight/ understanding of how teachers' values will deter, enhance, and influence teaching.

Ormrod and Cole (1996) obtained results supporting the beneficial effects of teaching content knowledge and pedagogical content knowledge to geography teachers in a two-week summer institute. Through on-site and follow-up self-evaluation questionnaires, plus post session telephone interviews, changes in content knowledge and pedagogical content knowledge were evaluated. The teachers involved in these programs not only gained knowledge of the subject of geography (content knowledge) but also pedagogical content knowledge for the subject area by developing new techniques of presenting specific material. The authors demonstrated that, although pedagogical content knowledge is increased through years of experience, it could also be enhanced through programs such as the two-week seminar of study on teaching a specific subject. They did not, however, address the possibility of incorporating this type of program into the pre-service teacher education training process.

Grossman and Richert (1988) maintained that lack of pedagogical content knowledge was a weakness in teacher education. Pre-service teachers had concerns regarding "how to conceptualize the subject matter for teaching (CK), how to teach particular topics (PCK), how to plan content specific units and lessons (PCK), what current resources and curriculum material (PK) are available" (p. 61). Numerous studies have shown that pre-service and beginner teachers have developed some pedagogical content knowledge through teaching, but their pedagogical content knowledge was to weak to provide them with the abilities to assess pupil performance and provide adequate or appropriate feedback to students (Florio-Ruane & Lensmire, 1990; Rovegno, 1992b; Wilson & Wineberg, 1988).

Marks (1990) studied fifth grade teaching of mathematics (specifically fractions) and stated that pedagogical content knowledge "represents a class of knowledge that is central to teachers' work and that would not typically be held by non teaching subject matter experts or by teachers who know little of that subject" (p. 9). He goes on to suggest changes in teacher education to include content relevant to the age group to be taught, and curriculum or methods courses which help to develop pedagogical content knowledge.

Lenze (1995) monitored (through interviews over a three-year period) four new faculty members, who taught either Spanish or linguistics, to determine how they developed pedagogical content knowledge. She confirmed that pedagogical content knowledge was discipline specific, related to teaching experience, enhanced through discussion with a reflective observer, and developed in differing amounts for each teacher.

As noted above, several studies have shown that pedagogical content knowledge develops with actual teaching experience. However, Rovegno (1994), when studying students involved in a physical education methods course, demonstrated that inadequate "pedagogical content knowledge, teaching and the school culture" (p. 279) can result in student teachers withdrawing to a "curricular zone of safety" (p. 279). This, in turn, limited further development of pedagogical content knowledge. Sebren (1995) observed a similar response of pre-service teachers in a physical education methods course when they lacked the ability to "respond pedagogically to students during an actual lesson" (p. 278). This would indicate that, ideally, pedagogical content knowledge should be developed in pre-service teachers prior to their student teacher experiences to assist in developing aspects of this type of knowledge and incorporating it within their early teaching experiences.

A study by Graber (1995) evaluated how student teachers in a methods course incorporated pedagogical content knowledge into physical education lessons. The study demonstrated the difficulty student teachers had in combining pedagogy and content for utilization as pedagogical content knowledge in lessons. In this study, the student teachers had not been taught pedagogical content knowledge, per se, but content and pedagogy separately. It was indicated that this obstacle was due to lack of competence in related content knowledge and teaching progressions, combined with an inability "to combine subject area expertise with appropriate teaching strategies" (p. 175). According to Graber, the student teachers in the study were aware of the value of pedagogical content knowledge for effective teaching, but had not been directly taught pedagogical content knowledge.

Ten years prior to Shulman's work, Hoffman (1977) ascertained that pedagogical knowledge was not enough for providing a complete education to children. Instructors must combine content knowledge with the knowledge of teaching processes to increase the effectiveness of teaching physical skills to children, adolescents and adults alike. Barrett (1985) identified the content for elementary school physical education as movement. She stated that content and effective teaching processes are both required to provide quality within the physical education program for children, but the roles each play are so important in design and implementation that they should be studied separately. However, according to Shulman (1987) there must be an amalgamation of the two to determine their combined effects.

Hoffman (1977) and Shulman (1987) both identified the combined function of pedagogy and content knowledge and its role in teaching. When teaching motor skills part of this combination is in the process of skill analysis (Hoffman, 1977). Skill analysis is the process of analyzing a movement through observation of the performance of the movement, and detection or diagnosis of the errors between the observed and desired movement, along with providing for potential intervention and remediation of the errors (Hoffman, 1977; McPherson, 1987). Hoffman's model of "Pedagogical Kinesiology" has been incorporated in many studies of skill analysis, but mostly from a pedagogical stand point and not an integrated approach as described by Shulman. (See Chapter 2, Pedagogical Knowledge.)

Walkwitz and Lee (1992a) attempted to "gain insight into the nature of pedagogical content knowledge in physical education" (p. 179). The study focused on the subject knowledge of eight kindergarten teachers with respect to the overhand throw, and how this knowledge translated into classroom events. The results revealed that the level of knowledge of the subject matter and pedagogical content knowledge made a substantial difference in the interpretations of observations made by the teachers which in turn was eventually reflected in student motor behavior, specifically the stepping action. The analysis conducted in this study lacked some precision in that it did not link the teacher's instructions with the responses of the children. As a result it was not clear if either content knowledge or pedagogical content knowledge was used by the teachers.

In her discussion of the development of dance instructors, Fortin (1993) also suggested that although "the technical content knowledge acquired as a dancer is indeed necessary, [it is] yet insufficient for quality teaching ..." (p. 38). She hypothesized that Shulman's concept of pedagogical content knowledge may provide the direction for transforming dancers into dance teachers.

Three studies by Rovegno (1992a, 1992b, 1993) suggest that the learning of pedagogical content knowledge can be incorporated in senior courses for physical education pre-service teachers. Rovegno (1992b) found that the participants in a field-based methods course in physical education increased their knowledge and understanding of the roles of task, individual and environmental aspects as related to their development of pedagogical content knowledge in which they were involved. In the next study, Rovegno (1992a) found that students using a movement approach to teaching had problems in understanding the uniqueness of the content areas of games, dance and gymnastics, and how this related to movement goals and variations. The relationship between types of activities and the learning goals of a program would be considered pedagogical content knowledge as there is the link between pedagogy (the approach to teaching), content (the types of activities) and the learning goals of the individual student (an aspect of PCK). In a third study (1993), Rovegno further examined the problems of teaching games strategies within a movement approach in a methods course. In this study she connected examples of pedagogical content knowledge with the concepts of advanced knowledge acquisition. Although this work identified many problems pre-service teachers had in developing pedagogical content knowledge, Rovegno concluded that the pedagogical content knowledge development for pre-service teachers would benefit "from more in-depth instruction" from faculty for the content area being taught. She also expressed the logistical concern that increasing instruction in one content/subject aspect would result in a decrease in time available for another aspect. Within all of these studies, Rovegno took the research of pedagogical content knowledge to another level by using examples of what the faculty in the teacher education programs taught and what the pre-service teachers were applying or developing.

Although not using the concept of pedagogical content knowledge, Stroot and Oslin (1993) examined the knowledge structure, observation skills and feedback prescribed in response to the observation of children when throwing by three pre-service teachers. The patterns appearing in the feedback provided showed that the pre-service teachers consistently addressed aspects of the skill which had high levels of efficiency. When the child demonstrated low efficiency of a component of the skill, little or no specific feedback was provided for that component. Also, when the pre-service teacher identified a low efficiency component and provided feedback relating to that component, change was observed. This study links ingredients of pedagogical content knowledge as it relates to identifying the level of ability of individual students, components of skill analysis in a physical activity setting, and the need for subject-specific (content) knowledge in skill analysis and motor development.

Barrett and Collie (1996) described the discovery of pedagogical content knowledge by observing children being taught by teachers teaching a sport for the first time. Four experienced physical education teachers who had not previously taught the sport of lacrosse, were observed teaching children in the fourth and fifth grade. By incorporating a hypothesized developmental sequence approach, the teacher's action were analyzed with respect to the children's movement patterns in the skill of the lacrosse cradle. It was determined that teachers need to assist children in using certain body components of the skill which will effectively enhance the developmental of the skill and overall performance. Teacher understanding of these components was resolved to be pedagogical content knowledge - lacrosse (PCK-L). Within the findings of this study, Barrett and Collie noted that "...the process of using PCK-L to effect motor development as a highly creative process ... takes thought, a commitment to helping children become increasingly skillful, and an understanding and respect for the nature of the subject matter and the time needed for developmental change to occur " (p. 307). PCK was reflected in this study in the pre-service teacher's skill of assessing the learner's needs and adapting the activity and teaching to assist the learner in advancing the skill performance.

Chen and Rovegno (1995) studied the acquisition of pedagogical content knowledge by two pre-service teachers in learning a movement approach to physical education, specifically in educational gymnastics and dance. They noted that there were two major problems in development of pedagogical content knowledge of the movement approach: 1) the pre-service teachers lacked an understanding of the difference between educational dance and gymnastics, and 2) they did not incorporate the use of guided and discovery teaching strategies. This indicates a weakness in both the content and pedagogical knowledge areas separately, as well as the integration of these knowledge areas into pedagogical content knowledge for the movement approach to educational gymnastics and dance.

Chen and Ennis (1995) examined the transformation of pedagogical content knowledge for curricular decision-making in secondary physical education volleyball units taught by three master teachers. The results of this study indicated that, although the teachers had similar content knowledge of volleyball, the pedagogical content knowledge displayed by each teacher differed according to the perception the teacher had regarding the "teachability" (p. 399) of the subject for their particular class. The interpretation by the teacher of the students' abilities led them to include or exclude curricula in their volleyball units (i.e., beginner versus advanced tasks). The process of curricula decisions, however, appeared to be characterized on a personal basis, not on actual observation of the learners. These findings indicate the importance of the inclusion of pedagogical content knowledge in teacher education programs, in order to identify teacher bias (beliefs) within curricular decision making. According to Shulman (1987), teacher bias and personalized approach to teaching is not a negative aspect, but should be recognized and understood as to how it influences and impacts on teacher decision making.

Studies examining pedagogical content knowledge have been mostly directed towards the comparison of the expert and novice teachers. More recent studies are beginning to address "how" the pre-service teacher learns and incorporates pedagogical content knowledge; however, these studies are based on examining a small group of subjects within the student teaching or fieldwork scenario. The studies do not address the teaching of content through the incorporation of a pedagogical processes specific to that content (i.e., PCK). Cochran, King, and DeRuiter (1991) suggested a working hypothesis for teacher preparation based on a pedagogical content knowledge approach. This approach indicated a close working relationship between content specialists, pedagogical experts and experienced teachers to fully develop teacher preparation programs. The recommendations also challenge teacher educators to incorporate a foundation of PCK in all the courses within and across the curricula.

A recent article provided specific direction for the application of pedagogical content knowledge into teaching. Griffin, Dodds, and Rovegno (1996) provided system for analyzing games and then applying that knowledge when teaching games by using a tactical approach. They also suggest that development of pedagogical content knowledge is an ongoing process used by a "committed professional".

Content Knowledge

Content knowledge for this study included aspects of motor development explained by maturation theory. According to maturation theory, as a child grows and develops, she/he will gain a repertoire of movement patterns and skills. Wickstrom (1983) advocated that movement skills are simple movements which combine into sequences to form a pattern. Many movement patterns can be observed in the performance of fundamental motor skills, where body segments are combined in a time-space arrangement to produce a specialized pattern. Gallahue and Ozmun (1995) described a hierarchy of movement that occurs through motor development. The initial level includes "reflexive movements" which provide the movement requirements to develop "rudimentary movements". The rudimentary movements are voluntary movement behaviors such as grasping, releasing, creeping, crawling and walking. As an outgrowth of rudimentary movements, "fundamental movements" develop that provide the eventual basis for the "sport related movements". Each level relies on abilities achieved in the previous level. The ability to perform advanced skills and sport skills is related to the ability to perform fundamental motor skills (Gallahue & Ozmun, 1995; Gallahue, 1982; Roberton & Halverson, 1984; Smith, Carlisle, & Cole, 1991).

Fundamental motor skills are observable movements basic to the motor development of children. The basic elements of these patterns should be similar for all children (Gallahue & Ozmun, 1995; Gallahue, 1982). The patterns defined as fundamental motor skills vary from author to author. For example, Wickstrom

(1983) includes "running, jumping, throwing, catching, galloping, skipping, kicking and climbing" (p. 7) as fundamental. Others have classified fundamental motor skills into categories according to the objective or function of the skill. Stewart and DeOreo (1980) divided skills into locomotor (walking, running, and jumping) and nonlocomotor (throwing and kicking) classifications, indicating movement of the body in space as compared to the movement of an object in space. Fundamental motor skills have also been classified into locomotor, nonlocomotor and manipulative categories (Graham, Holt-Hale, & Parker, 1993; Wall & Murray, 1994).

Included within the locomotor category are running, jumping, skipping, galloping, hopping, leaping, and sliding. A number of authors (Gallahue, 1987; Roberton & Halverson, 1984; Seefeldt, 1979; Ulrich, 1985) simply identify these skills as locomotor, while others (Gallahue, 1982, 1987; Graham, et. al., 1993; McClenaghan & Gallahue, 1978; Wickstrom, 1983) indicate that skills beyond a run and jump are second level locomotor skills, requiring a combination of the run and jump. For example, the leap is a form of the jump and appears most often in a child's skill repertoire prior to the gallop or slide, just as a gallop usually precedes a skip (DeOreo & Keogh, 1980; Gallahue, 1982; Roberton & Halverson, 1984; Wickstrom, 1983). Gallahue (1987), Humphrey (1980), and Wall and Murray (1994) identified stability and balance as nonlocomotor. Manipulative or object control skills are those motor patterns which include control over an external object. Throwing, catching, kicking, striking, and bouncing are the fundamental motor skills included within this category (Gallahue, 1982; Roberton & Halverson, 1984; Ulrich, 1985; Wickstrom, 1983).

Despite the different ways to categorize fundamental motor skills, consensus among authors generally includes the following skills as fundamental: running, jumping, throwing, kicking, striking and catching. These skills have also been identified by Wall (1982) as culturally normative, indicating that they are commonly used as basic sport skills by the majority of children in North America. All of these skills provide the basis for optimal participation in physical activity pursuits such as in play, games, sports, and gymnastics.

Children typically begin developing fundamental motor skills between the ages of two to seven years (Gallahue & Ozmun, 1995; Gallahue, 1987; Haywood, 1993; Payne & Isaacs, 1995). Movement patterns in these skills have been examined by many researchers and authors (Branta, Haubenstricker, & Seefeldt, 1984; Gallahue, 1982, 1987; Roberton, 1977, 1978; Roberton & Halverson, 1984; Thomas & French, 1985; Ulrich, 1985; Wickstrom, 1983). A mature pattern in fundamental skills is characterized by mechanical efficiency, co-ordination and controlled performances (Gallahue, 1982). Many children, however, will not attain a mature pattern in some fundamental motor skills until they are in primary school (Gallahue, 1987; Wickstrom, 1983). In fact, some people may never develop mature motor patterns for some fundamental motor skills in their lifetimes (Gallahue, 1982, 1987; Wickstrom, 1983). This indicates that, although the early elementary school years are spent learning and refining these skills, some children will not achieve the mature pattern during these years.

Most authors agreed that the critical time in which to develop mature motor patterns for fundamental motor skills is childhood, and if the skills are not developed to a sufficiently efficient form during this period, they often remain unrefined indefinitely.

Most children participate naturally in play activity that will facilitate the development of many movement skills. As the child develops, the movement patterns combine to form the initial pattern of fundamental motor skills. The initial level is where the skill can be described on the basis of a goal-oriented definition (i.e., a throw is the forward projection of an object from the hand). From the initial level, most children will progress through similar sequences in the development of each skill until reaching a more advanced pattern.

Gallahue (1982) and Wickstrom (1983) have examined and labeled whole body sequences of development for fundamental motor skills. These sequences identify the progression a person will make from the initial level to the mature pattern a skill for all body components, simultaneously. Although sequences have been identified in most of the fundamental motor skills, not all of the sequences have been validated (Haywood, 1993). Many of the hypothesized sequences indicate steps through which a child will progress in the development of fundamental motor skills. Roberton (1977, 1978) has examined the developmental sequences of the overhand throw, and has developed a component model where each of the various body components follows a series of steps in the developmental process. For example, the forward action of the overarm throw included the upper arm as progressing through three steps of development, the forearm action through three steps, the leg four steps, and so forth. Roberton and Halverson (1984) have hypothesized component models for most fundamental motor skills. Although many of these have also not yet been validated, they have nevertheless been used in research to describe the steps of development as compared to performance outcome measures such as distance, speed, etc. (Halverson, Roberton, & Langendorfer, 1982; Morrison & Harrison, 1985; Mosher & Schutz, 1983; Nelson, Thomas, Nelson, & Abraham, 1986).

The rate of this progression, or the time spent at any one sequence, varies from child to child. Thus, children can develop fundamental motor skills at different rates which are not age-dependent (Gallahue, 1982, 1987; Haywood, 1993; Wickstrom, 1983). In early childhood, children discover a variety of locomotor, stability and manipulative motor skills. These may be experienced in isolation or followed by combinations with other skills. The fundamental motor skills develop as a child learns to respond to a wide variety of stimuli which appear in the environment (Gallahue, 1982, 1987; McClenaghan & Gallahue, 1978; Wickstrom, 1983). A major misconception about the developmental concept of the fundamental movement phase is the notion that these abilities are maturationally determined and are not heavily influenced by environmental factors (Gallahue, 1982, p. 45). Although maturation plays a role in the development of fundamental motor skills, opportunity, motivation and instruction have also been demonstrated as key to the degree of ability achieved in fundamental motor skills (Branta, et. al., 1984; Gallahue, 1982, 1987;

McClenaghan & Gallahue, 1978; Roberton & Halverson, 1984; Thomas & French, 1985).

Children should be given the freedom to explore movements and the opportunity to successfully participate in physical activity. This opportunity must be equal for both boys and girls. Halverson, Roberton, and Langendorfer (1982) suggest that some boys and girls have not reached a mature pattern in throwing by the age of 13 years, but are still perfecting some components of the overarm throw. The developmental process of the overarm throw by girls lags behind boys, as noted in several studies (Brophy, 1948, as cited in Halverson, et al., 1982; Espenschade & Ekert, 1968; Glassow, Halverson, & Rarick, 1965 as cited in Halverson, et al., 1982; Leme & Shambes, 1978; Stewart & DeOreo, 1980). The children who have not achieved a mature motor pattern may have ceased their development for a number of reasons, including lack of motivation and opportunity. If a child has stopped the developmental process in fundamental motor skills, through lack of opportunity, motivation or instruction, she/he can still progress to the mature pattern (Halverson, et al., 1982; Gallahue, 1987; Gallahue & Ozmun, 1995; McClenaghan & Gallahue, 1978; Smith, et al., 1991). Opportunity for the advancement of fundamental motor skills for those who are delayed in the development, and for refinement of these skills for those who are not delayed, arises in physical education classes once the child begins school (Gabbard, LeBlanc, & Lowy, 1994; Gallahue, 1982, 1987; McClenaghan & Gallahue, 1978; Pangrazi & Dauer, 1995; Smith, et al., 1991). Seefeldt (1979) suggested that children require assistance in overcoming the barrier between proficiency in fundamental motor skills and the automation of the skill which can then be used in a more complex setting. Several authors have also stated that elementary schools should provide a program beyond free play to encourage the building and perfecting of fundamental motor skills (Gabbard, et. al., 1994; McClenaghan & Gallahue, 1978; Pangrazi & Dauer, 1995).

Despite the lack of validation of the hypothesized developmental sequences of fundamental motor skills, there is extensive information regarding the development of fundamental motor skills to provide knowledge for teachers. Unfortunately, most textbooks on teaching elementary school physical education are limited in the presentation of this content knowledge. If teachers are not aware of the information regarding the developmental process of fundamental motor skills, or the mature movement patterns of these skills, they lack the content knowledge required to assess a skill performance. A knowledge base, whether biomechanical, anatomical or technical (form), is key to skill analysis (Arend & Higgins, 1976; Barrett, 1979a, 1979b; Barrett, Sebren, & Sheehan, 1991; Hay & Reid, 1982; Hensley, 1983). The extent to which this knowledge base affects the ability of an instructor to analyze skills has not yet been determined.

Pedagogical Knowledge

Pedagogical knowledge encompasses the strategies and methods that a teacher uses in the classroom to provide the organization necessary for the learning of the subject (Shulman, 1986). Under the general principles of pedagogical knowledge, elementary school teachers who are responsible for teaching physical education to their students, must be able to provide a planned program experience to encourage their students to develop and advance their fundamental motor skills (McClenaghan & Gallahue, 1978). They must not interrupt the process by providing opportunities which are too complex, or by pushing the child into skills in which they will not be successful (Roberton & Halverson, 1984). They also need to be able to assess the abilities of their students in the performance of fundamental motor skills through organized observation, and finally, be able to guide the child by providing appropriate feedback (Gallahue, 1987; Graham, et al., 1993; Hoffman, 1977). Kernoble and Carlton (1992) suggest the type of feedback provided should be specific to the phase of the skill (preparation, force production, follow-through) and action of a body part (arm, trunk, leg) for best results by the learner. These processes are general principles of teaching (pedagogical knowledge) which would be transformed to pedagogical content knowledge with the addition of the specific aspects of the structure of the skill including actions of the body components (content knowledge).

The section on pedagogical knowledge is divided into several pedagogical components related to analyzing skills for the purpose of creating feedback: skill analysis, skill performance experience, teaching experience, observational strategies, diagnosis and remediation, training in skill analysis of sport skills, and training in skill analysis of fundamental motor skills.

Skill Analysis

Understanding the components of a skill has been determined as a necessity in the skill analysis process. Skill analysis is the precursor for the provision of feedback given by the teacher to assist the student in making appropriate adjustments for the improvement of their next skill performance. This process reflects the use of pedagogical knowledge (in the use of observation and provision of feedback). Skill analysis could be related to two questions: a) What is happening in the skill performance? b) What must occur to improve the performance? For effective skill analysis to be completed the observation must be compared to the critical components needed to perform the skill (content knowledge). This includes an understanding of the objectives of the skill, classification of the movement and decisions of what to observe.

An understanding of the mechanical principles involved in the skill is considered to be a foundation upon which to base observations (Hay & Reid, 1982; Hensley, 1983; Hoffman, 1977; Knudson & Morrison, 1997). A qualitative model can then be designed to show the relationship of the principles or factors and the desired result. Also, the skill may be broken into distinct consecutive parts such as preparation, force production and follow-through. The model is simplified by examining the biomechanical components which apply to parts of the skill.

Knowledge of the critical features of the skill has also been identified as a requirement for pre-observation (Arend & Higgins, 1976; Barrett, 1979a, 1979b, 1983; Brown, 1982; Hoffman, 1977; Kreighbaum & Barthels, 1985; Newston, 1976; Robb, 1972). The critical features are the aspects of the skill which are requirements for the desired outcome of the skill. Critical features provide direction for the movement technique used in performing a skill efficiently. Although individual differences may appear in the performance of a skill due to personal characteristics, a basic technique or pattern can be demonstrated to be effective and efficient for most people. For example, Ashy, Lee, and Landin (1988) illustrated how practicing a soccer skill using correct technique resulted in greater student achievement in performing the skill than did practice without technique focus. The amount of information presented in critical features of a skill, however, may be too great for the teacher/coach/observer to handle at any one time, and the more skilled observer will select "...the least redundant set of critical features for the perceptual organization of the event..." (Newston, 1976, p. 120).

A combination of the biomechanical model and critical features are used to evaluate skill performance and determine the sources of errors. These essential factors provide a focus of components which may limit performance. The research which has been conducted on the role of knowledge, as applied to the ability to assess fundamental motor skills, is very limited. Research using skill analysis of fundamental motor skills as the dependent variable has been conducted using combinations of models and will be discussed later.

Skill analysis has been the focus of research in a variety of settings. The observer's experience in performing a skill, teaching experience, knowledge of the performer and performance outcome, observational strategies, diagnosis and remediation, and training in movement analysis are among the variables studied with respect to the ability to analyze motor skills.

Experience in Performance of a Skill

Girardin and Hanson (1967) studied the relationship between abilities to perform and observe tumbling skills, by 32 male undergraduate physical education students. A significant relationship was found between tumbling ability and the assessment of errors. There were, however, no controls for the level of tumbling experience nor was a validated instrument used in error detection.

Osborne and Gordon (1972) and Armstrong (1976) found that there was no significant relationship between performance and skill analysis of a tennis stroke, and physical training (kinesthetic experience) of a novel skill and skill analysis of a model of the movement pattern, respectively. There is little evidence to support the hypothesis that experienced performers are better at skill analysis than novice performers.

Teaching Experience

Experience in teaching and coaching physical skills has been hypothesized as enhancing the ability to analyze skills (Armstrong, 1986). Biscan and Hoffman (1976) found that physical education teachers and undergraduate students who were familiar in teaching the cartwheel were superior at analyzing that skill when compared to classroom teachers and students without teaching experience. When analyzing a novel skill, no significant differences were observed.

Armstrong and Hoffman (1979) found similar results when examining analytic ability of tennis instructors. Instructors with greater experience teaching tennis had a superior ability in identifying performance errors. Imwold and Hoffman (1983) also showed that experienced gymnastics coaches were significantly better at recognizing previously viewed gymnastics performances than both physical education teachers and undergraduates. Imwold and Hoffman concluded, therefore, that it may be unrealistic for physical education teachers to "...markedly improve their diagnostic skills in post-graduate years..." (p. 154) due to the diversity of their teaching responsibilities. As teachers and coaches gain experience in skill analysis the accuracy and proficiency of the analysis improves.

Observational Strategies

Most research conducted on the observation of motor skills has combined the knowledge component of skills with the actual observation process (Arend & Higgins, 1976; Godwin, 1975 in McPherson, 1987; Hoffman, 1977; Imwold & Hoffman, 1983; Newston, 1976). Godwin (1975, in McPherson, 1987) included the selection of what is to be observed, methods of looking, and categorization, assessment and evaluation as part of the observation process. Newston (1976) described a monitoring process where the motor sequence was divided into parts based on its critical aspects, and suggested the importance of predictive features that would indicate a change about to take place.

Based on the work of Rudolf Laban (cited in Wall & Murray, 1994) a system of observing movement grounded on four major components had been used: body (what the body can do); space (where the body moves); effort (how the body moves); and relationship (with whom or what the body moves). This model provides an effective means for classifying and describing the movements observed, but does not provide the knowledge or system for error detection or remediation.

Barrett (1983) identified observation as a key component in the teaching-learning cycle. From this she designed a hypothetical model for observation to include three components: (a) deciding what to observe; (b) planning how to observe; and (c) knowing what factors influence the ability to observe. Within the model, a major portion of the observation process involves identifying critical features and movement analysis process. The model identified many vital components to be considered in skill analysis (e.g.,, angle of observation) and Barrett provided a few strategies and recording methods to be used when observing.

Observation strategies have also been presented in the form of a checklist (Cooper, 1972). This approach was constructed from a biomechanical perspective focusing on a hierarchy of movement components which focused on the center of the body, and working toward various body parts, in order of importance to the skill. Gangstead and Beveridge (1984), and Beveridge and Gangstead (1988), modified this approach in their application to qualitative skill analysis. This process focuses on the "hub" or center of the skill and moves towards the actions of the perimeters. This method assisted in the identification of errors which may be symptoms of other errors, and did not address the provision of feedback resulting from the analysis.

Brown (1984) developed a series of visual techniques to help voluntary coaches who had little or no experience with kinesiology or biomechanics. The focus of the techniques was in the evaluation of the quality (process) of the movement observed. The techniques were based on mechanical principles and critical features. However, although the coaches improved their observational abilities, they had difficulty differentiating between the primary source of the error versus secondary sources, as was found in Cooper's (1972) study.

Bard & Fleury (1976) reported differences in the location and number of eye fixations by experienced and inexperienced basketball players when performing a problem-solving task of offensive basketball situations. Bard, Fleury, Carriere, and Halle (1980) found similar results when they examined visual search patterns of gymnastics judges, and found that expert judges concentrated on critical features of different parts of the body with fewer visual fixation (focus) points than less experienced judges.

Observation strategies and models have been the center of many studies, providing methods of simplifying the complexity of the task. The processes emphasize how to focus observations to gain accurate information about the performance.

Diagnosis And Remediation

The preceding models have been concerned with the process of skill analysis but what follows the observation of motor skill? Arend and Higgins

(1976) provided a process which effectively combined three phases of skill analysis (pre-observation, observation, post-observation) in one approach. In the pre-observation phase, they identified critical features and biomechanical principles involved in the skill. The observation phase included the focal point(s) to be observed and recording system for this process, followed by a diagnosis of errors of the observed performance and the organization of feedback in the post-observation phase. The weakness in this design was in the lack of observational strategies such as regarding angle of observation, and elimination of distractions.

The Hypothetico-deductive Model designed by Hoffman (1982) extended the observation process one step further to the diagnosis of errors in skill performance. Hoffman based the model on the assumption that there is a specific desired motor response. If the observed skill is not performed correctly according to the identified requirements, a process is followed to identify the error and prescribe a remedy for correction. The model allows for the identification of the nature of the error through deductive reasoning regardless of the cause of the error (individual ability, performance deficiency, or psychosocial problems). Hoffman also indicated that the relationship between ability to detect errors and the knowledge of biomechanical principles has not been established, but have been based more on the critical features of the skill (content knowledge).

Training In Skill Analysis

Research examining the development or effectiveness of training programs for pre-service or in-service teachers in motor skill analysis is limited. Undergraduate courses in kinesiology and biomechanics have often been presumed to develop the ability of teachers and coaches to analyze movement. Locke (1972) and Hoffman (1977) theorize that these courses have been deficient in providing teachers with the ability to analyze or evaluate physical skill performance. These were similar to the concerns of Huestler (1939) that courses in anatomy, mechanics and kinesiology do not assure future instructors an improvement in ability to analyze skills in the gymnasium or on the playing field, let alone intervene effectively. As a result numerous studies have examined the training of teachers and coaches in skill analysis.

The ability to analyze a novel and familiar skill by teachers and students was the focus of a study by Biscan and Hoffman (1976). Experience and the amount of exposure to the visual stimuli, rather than knowledge of kinesiology, were determined as influencing analytic ability. Hoffman and Armstrong (1975, in McPherson, 1987) also studied the effectiveness of a short-term training program on the ability to detect movement errors. The program had no effect on the ability of the pre-service physical education teachers to identify errors.

Armstrong and Imwold (1982, in McPherson, 1987) piloted a training program that provided instruction in observation, diagnosis, response modification and provision of feedback. Although this program was not tested empirically, the authors felt the program provided means to improve on previous skill analysis training efforts.

Gangstead (1982) also designed an instructional program that incorporated an observation model to aid skill analysis by undergraduate physical education majors. The experimental group demonstrated a significant difference from the control groups in the perceptual and diagnostic ability. Gangstead concluded that the program was effective in providing observational and analytic ability for skill analysis.

Kniffen (1986) attempted to provide a training package for skill analysis by the use of video-tape instruction. The objective of the study was to improve, through a video intervention, the ability of undergraduate physical education majors to verbally identify critical features of various sport skills and discriminate between the elements which were performed correctly or in error. Kniffen's study showed that analysis of each sport skill improved following the instructional intervention regarding that sport skill, therefore, suggesting that teaching analytic skill can change teacher behavior in specific skill analysis.

The effects of a 12 week (3 hours per week) generic conceptual movement-analysis training program on the provision of feedback by pre-service physical education majors and minors was examined by Nielsen and Beauchamp (1991). The pre-test/post-test experimental design showed a significant increase in the corrective, accurate trial-specific feedback on the two skills (a familiar volleyball skill and a novel team handball skill). Provision of feedback was not influenced by gender, major/minor status, or volleyball experience in high school, but was related to educational program entry level and achievement level during the training program. In other words, those who demonstrated a significant gain in the knowledge of movement analysis as provided in the training program, were also more effective in providing corrective, accurate feedback.

Wilkinson (1986) used three volleyball skills to examine the effects of a visual discrimination training program. Using a pre-test/post-test experimental design with two control groups, she administered intervention to teach visual discrimination in volleyball. Neither of the control groups received the visual discrimination package, but one of the groups was involved in all other volleyball activities with the experimental group, while the other participated in another similar volleyball program. Although all groups improved in their volleyball skill analytic ability, the experimental groups had significantly higher scores in each skill analysis procedure. In a second study, Wilkinson (1991), using a multiple baseline approach, observed abrupt improvements in correctly analyzing the volleyball skills. Wilkinson (1996) also applied a visual-discrimination training program to the overarm throw and the related sport skills of the badminton overhead clear, tennis serve and volleyball serve, plus an unrelated skill (standing long jump). Using a pre-test, post-test design, she found that there was a significantly difference in post-test scores between the control group and training group for all skills except the standing long jump. These three studies provided support for training programs for skill analysis.

McPherson (1987) also used a multiple baseline approach in designing, implementing and evaluating a program to promote skill analysis competency. The subjects in this study also improved their ability to identify errors and to determine primary errors following the application of a skill specific analysis paradigm. The subjects improved their ability to identify errors correctly but could not effectively identify the source of the error.

Morrison and Harrison (1985) examined the effect of a 42 minute video instructional program on developmental aspects of fundamental motor skills on the ability of pre-service and in-service elementary generealist teachers to analyze the skills. The skills examined were throwing, catching and striking. The experimental group had a significantly higher mean score on the post-test than the control group, indicating a benefit of the instructional unit. The analytic ability of the experimental group was retained during an eight-week period following the instructional unit as indicated through a second post-test. The initial level of knowledge of fundamental motor skills and analytic ability was not determined for each group, nor was there a determination of how the improved observation ability would affect the provision of feedback.

Painter (1994) reported that kinesiology and elementary education students required one to five trials to reliably assess leg and arm actions of children's hopping performances. The students participated in a two-hour training program in either the whole body or component model describing developmental sequences in hopping. The study did not compare the effectiveness of the two models, but focused on the reliability of accurate assessment based on the number of observations required. The two-hour training program appeared to be beneficial under these conditions.

Summary

Shulman (1987) has described a theoretical framework for teaching reform which includes subject or content knowledge (CK), teaching process/curricular knowledge or pedagogical knowledge (PK), and pedagogical content knowledge

(PCK) as the basis for the knowledge teachers require to be effective in their chosen field. Shulman's approach to instruction requires that teachers possess several types of knowledge and that they are able to apply knowledge appropriately. By examining teacher's use of knowledge in relation to expected outcomes of their teaching (e.g.,, improved motor skill performance), one can determine what is appropriate for teacher education programs.

There exists general agreement that fundamental motor skills provide the basic skills needed for the advanced learning of sport skills and more complex skills of different physical pursuits. Although some authors include a great variety of skills as fundamental motor skills, running, jumping, catching, throwing, kicking and striking are agreed upon as being fundamental. It is also evident that the development of the fundamental motor skills continues into elementary and middle school years, and that some children require assistance in learning the basic patterns of these skills. Therefore, teachers require the knowledge and ability to assist the students in becoming competent in these skills. Yet, skill analysis has not been included as part of many elementary education undergraduate programs.

Several studies have examined portions of skill analysis using pedagogical (PK) and content knowledge (CK). Most of the studies have examined sport skills, which are combined and refined fundamental motor skills, as the items for analysis. Oslin, et. al. (1997), Walkwitz and Lee (1992a), Stroot and Oslin (1993), and Morrison and Harrison (1985) have conducted the only studies to date identifying the importance of elementary school teachers using skill analysis to evaluate and identify errors in the performance of fundamental motor skills. However, these studies failed to investigate the whole process of problem solving in skill analysis to the culmination of the provision of feedback for improvement of performance, described as essential by Hoffman (1982).

The studies examining the development of pedagogical content knowledge have indicated that teachers gain this knowledge through experience. A common suggestion has been that inclusion of an understanding of pedagogical content knowledge in teacher education programs would enhance teaching ability. Only recently has research been designed to examine how to incorporate pedagogical content knowledge within a subject area or whether initial benefits can be observed in teacher knowledge through inclusion of a pedagogical content knowledge approach to teacher education. Rovegno (1992b) identified that pre-service teachers, in developing pedagogical content knowledge, had difficulty in creating statements of feedback despite their knowledge of the skill and experience in performing the skill, although the reason for this deficiency was not identified. Marks (1990) suggested that teacher education should include pedagogical content knowledge by teaching future teachers content relevant to the age group to be taught. The research in this area has only examined the development or incorporation of pedagogical content knowledge within the actual teaching environment, for example, in student teaching scenarios. It may be that pre-service teachers are more concerned with what and how they teach than whether the learner is learning, which would indicate the use of pedagogical content knowledge.

It is suggested in the literature that the knowledge components required to enhance elementary education teachers' abilities in assisting children in the development of fundamental motor skills are available. The method of providing this teacher education is still in question though. The question remains, therefore, one of whether the content should be taught separately from the pedagogical processes required, or whether an integrated approach to teacher education should or can be utilized through a pedagogical content knowledge approach.

This study was an attempt to address this question by presenting three teaching scenarios of pedagogical, content, and pedagogical content approaches for teaching skill analysis of two fundamental motor skills to pre-service teachers.

CHAPTER 3

METHOD

One purpose of this study was to develop educational programs of pedagogical knowledge, content knowledge, and pedagogical content knowledge for skill analysis of the developmental components of standing long jump and overarm throw as performed by children. The knowledge levels of pre-service teachers receiving these programs were then compared to determine the effectiveness and consequences of each program in conducting skill analysis. This chapter will provide a description of the method used to achieve these purposes. Research design, subjects, testing instruments, as well as the nature of the treatments will be discussed.

Research Design

Previous studies examining pedagogical content knowledge of teachers have been mostly descriptive, correlational, or comparative between novice and experienced teachers. Studies have not examined the differences of teaching pre-service teachers with programs based on different knowledge types as defined by Shulman (1987). For this study, a pre-test/post-test quasi-experimental design was used in order to address the research question. An experimental design provided a means of comparing the knowledge differences of the subjects as they did simulated analysis of the two fundamental skills performed by children and provided feedback for those children. The quasi-experimental pre-test/post-test design with control group was selected for the study due to the availability of "naturally assembled" (Campbell & Stanley, 1969,

p. 47) groups within the Faculty of Education at the University of Alberta. Three experimental groups and a control group were included by using intact groups randomly assigned to treatment or control. The three treatment groups received different treatment packages providing general pedagogical knowledge (PK), content knowledge (CK), or pedagogical content knowledge (PCK), respectively. Table 1 provides a representation of the research design.

Table 1

Research Design

PHASE	GROUPS			
	PK	CK	PCK	C
Pre-test[a]	Yes	Yes	Yes	Yes
Treatment	Pedagogical Knowledge	Content Knowledge	Pedagogical Content Knowledge	No Treatment
Post-test[a]	Yes	Yes	Yes	Yes

[a] Pre-test/post-test consisted of 3 measurements: content, feedback, and observation

Subjects

Subjects included 100 undergraduate students (77 females and 23 males) registered in one of two required elementary education physical education courses (Appendix A) at the University of Alberta. The mandate of the two courses identified for recruitment of subjects, PESS 292 and 293, is to provide the content knowledge requirements in physical education for the generalist elementary education undergraduate degree. The students were required to take one of the two courses. Both courses included content relating to fundamental motor skills and observation and analysis of skills used by children. Involvement in the study was voluntary however all class members participated in the treatments applied to their particular group and the debriefing period, as part of the course content. The subjects completed an "informed consent" form (Appendix B) one week prior to participation in the study and could withdraw at any time from participation in the study testing procedures. The majority (97%) of all students enrolled in the courses chose to participate in the study while the other three percent were not involved in the testing procedures. The group designation was through the use of four intact classes, each class forming an experimental or control group. A pre-test was used to evaluate initial equivalence of the groups on all dependent variables.

Treatments

The three experimental groups participated in their designated treatment programs following the pre-test. The control group participated in regular course activities for a similar time period following the completion of the pre-test and prior to the administration of the post-test. (These activities were relevant to the course but not related to motor development, feedback provision, or skill analysis. The aspects of the treatment were received by this group following the completion of the research data collection.)

The treatment programs were designed to enhance one of three "knowledge" categories defined by Shulman (1987). The Pedagogical Knowledge (PK) group received instruction on the pedagogical processes of observing skills and providing feedback to individuals for skill improvement in a physical activity setting. The treatment designed for Content Knowledge (CK) group was based on the subject-specific knowledge of developmental sequences of the standing long jump and forceful overarm throw, only. The Pedagogical Content Knowledge (PCK) group received an instructional package on skill analysis incorporating a pedagogical content knowledge approach, that integrated the pedagogical processes of observation of individual skills and provision of feedback in a physical education setting with the content knowledge of developmental sequences of a standing long jump and forceful overarm throw as described by Roberton and Halverson (1984), Gallahue (1982), and Seefeldt and Haubenstricker (1982).

In designing the treatment packages, Hoffman's (1977, p. 43-47) article, "Toward a Pedagogical Kinesiology", was used as a guide. Hoffman included aspects of content and pedagogy which link well to Shulman's definitions. Hoffman suggested that developing teachers' analytic skills will involve the following characteristics:

1. An emphasis on teaching motor skills. This section stressed the importance of skill analysis of fundamental motor skills by elementary school teachers.
2. An emphasis on skill acquisition. Factors that influenced skill acquisition of fundamental motor skillss were examined within this segment.
3. An emphasis on observational training. Barrett's (1983) "Hypothetical Model of Observation as a Teaching Skill" was incorporated to identify critical aspects of observing in a physical education setting.

4. Evaluation of responses according to specific qualitative criteria. This section included two sets of criteria. Firstly, identification of the critical features of the developmental sequences of fundamental motor skills formed the specific content knowledge. Secondly, the use of biomechanical principles to evaluate motor performances provided alternative qualitative criteria.
5. Diagnosis for Feedback. Hoffman's (1982) diagnostic model provided the basis for diagnosis of the performance and formulation of the feedback to provide instruction in advancement of future skill performances.
6. Provision of Feedback. An emphasis on the communication of information about movement. In this section the information from the previous sections was used to formulate statements of feedback to assist in advancing the skill to a more mature pattern.

These characteristics were used to guide the development of the three treatments based on the type of knowledge focus required.

Of the six characteristics, the first two were presented as an introduction in all three experimental treatments. The "emphasis on observation", "diagnosis for feedback" and "communicating information" aspects represented pedagogical knowledge and was presented as part of the PK program. The "specific qualitative criteria" characteristic represented content or subject-specific knowledge and was, therefore, incorporated into the CK treatment. The treatment designed for the PCK treatment integrated the pedagogical and content knowledge segments to provide a process-oriented approach of teaching developmental motor skills and the methods and strategies required for aiding children in the acquisition of the skills (Shulman, 1987). In the PCK treatment, section three through six were combined at all levels to integrate the information, while in CK and PK these aspects of the treatments were taught as separate components, where applicable. The portion of the program dealing with biomechanical principles was to provide a conceptual aspect to skill analysis for all of the experimental groups as a pedagogical connection for skill analysis. A conceptual training approach has been shown to improve the feedback provision patterns of pre-service secondary physical education teachers (Nielsen and Beauchamp, 1991) and was considered to be a valuable component for all experimental groups. It was not the investigator's intention, however, to evaluate the ability of the subjects to integrate this component within skill analysis of the standing long jump or forceful overarm throw. A summary of the treatment components is presented in Table 2.

The treatment packages for all groups were taught by the same instructor, but this instructor was not the regular classroom instructor. The time allocated to each treatment was equivalent while the tasks within the treatments varied dependant on the approach of the treatment.The total time of each treatment was approximately 140 minutes.

Table 2

Summary of Treatment Components

Treatment Phases	GROUPS			
	PK Pedagogical Knowledge	CK Content Knowledge	PCK Pedagogical Content Knowledge	C Control
Teaching Motor Skills	X	X	X	
Acquisition of Skill	X	X	X	
Observation Training	X		X	
Specific Qualitative Criteria				
a. fundamental motor skills		X	X	
b. mechanical principles	X		X	
Diagnosis for Feedback	X		X	
Provision of Feedback	X		X	

Note. "X" indicates the item was included in the treatment.

Pedagogical Knowledge Treatment Program (PK)

The PK treatment group received an introduction to the program which placed an emphasis on teaching and acquisition of motor skills. The focus of this part of the treatment was to identify the importance of motor skill acquisition and the role the teacher can play in assisting children to become well skilled in fundamental motor skills (Gallahue, 1993; Kirchner, 1992) including factors which may influence motor skill acquisition. The focus of the treatment was on the process of observation, diagnosis for feedback and communication of feedback. Techniques for observing individual skill performance in a physical education setting were provided using Barrett's (1983) "Hypothetical Model of Observation".

Subjects were instructed on how to plan for observation and what influences observation of two skills: kicking for accuracy and balance. Within the aspect of "deciding what to observe", instruction on the biomechanical principles of the summation of joint forces (number of joints and sequence of use), and phases of skills (preparation, force-production, follow through) were incorporated (Coaching Association of Canada, 1983). The subjects then observed each other performing the two sets of skills in a variety of activities. Focus was directed towards watching the skill as a whole before focusing on a specific body part. The subjects were also instructed to observe more than one performance by an individual to determine if the skill characteristics observed were consistently demonstrated. With the object control skill, many of the subjects began by observing the object rather than the performer. Once directed to observe the performer, the skill became more clearly observed.

Following the observation in each scenario, the subjects were involved in a group discussion describing what they observed at various points of the activities, how slight alterations in the tasks altered their ability to observe, and the adjustments required to create a good observation as each task was altered. Group discussion continued examining how the observations noted could be converted into providing feedback to the performer which would assist them in improving their next performance. The focus on the feedback was to create statements that were corrective in nature, accurate to the performance observed and specific to timing and body component (Nielsen & Beauchamp, 1991; Siedentop, 1991). During this element each subject produced feedback statements after observing a specific skill (kicking, balancing). The subjects recorded their feedback statements. Through class discussion, statements were evaluated based on the inclusion of "corrective, accurate, specific" components.

Group PK was also involved in observing children at play. This was a class assignment which had been planned by the group prior to the onset of this study. A play setting was designed within a university gymnasium and incorporated five settings which would encourage manipulation of a variety of objects, locomotion, balance and stability. During the observation period, the course and research instructors provided assistance in observing the children in the performance of specific skills and an examination of components within the Barrett (1983) model, plus the creation of feedback statements (although providing feedback to the children was not a requirement of the assignment).

This treatment was concluded with a summary of the observation model and feedback components stressed within the sessions.

Content Knowledge Treatment Program (CK)

The CK treatment group received a similar introduction to the treatment program as delivered to the PK group including teaching and acquisition of motor skills as well as the biomechanical principles. The main focus of instruction for this group was on developmental sequences and patterns for the fundamental skills of throwing for force and jumping for distance. The information was provided through a lecture format using developmental sequences for the two skills as described by Roberton and Halverson (1984). The sequences were first examined through the use of overhead transparencies focusing on the jump followed by the overarm throw. This instruction was followed by observation of children's video-taped performances of the two skills. During this section of the treatment, the subjects were asked to compare the developmental sequences described in the previous session on developmental sequences to the observed performances. Examples of five to seven children of varying ages were observed for each skill and "slow-motion" speed was often utilized if the subjects had difficulty in identifying or categorizing the features observed. Once again, the jump was studied first followed by the throw. Approximately half of the treatment time was designated to visually identifying examples of the components described by Roberton and Halverson through the use of video-tape. The focus of the conclusion for this group was on highlighting the sequences of development for the standing long jump and overarm throw, and identifying where similar information could be obtained for other skills.

Pedagogical Content Knowledge Treatment Program (PCK)

The treatment program for PCK consisted of an emphasis on the communication of information about movement using Hoffman's (1977) "Pedagogical Kinesiology" as a guide. Hoffman proposed a method of skill analysis for physical educators which mirrors Shulman's concept of pedagogical content knowledge. The program incorporated lectures, video-tapes, practical experiences and discussion which were presented to integrate areas of Hoffman's program. The introduction to the program was the same as the one received by the PK and CK groups which placed an emphasis on teaching and acquisition of motor skills. The treatment then examined Barrett's (1983)

"Hypothetical Model of Observation" and how observation, which if well organized and completed, could be incorporated into creating individual feedback for students which would be corrective, accurate and specific to the task(s) performed. The subjects were provided with an outline of developmental sequences (critical features) for the jump and throw as described by Roberton and Halverson (1984) in order to provide specific qualitative criteria about the skills. The subjects received instruction on two basic biomechanical principles to assist in coordinating or organizing the observations and analysis of physical skills. The principles included were: summation of joint forces (increasing the number of joints used and using the joints in sequence) and phases of skill performance (preparation, force-production, follow through) (Coaching Association of Canada, 1983). The subjects were then involved in peer observation to identify each component and provide feedback. The same procedure was followed with the overarm throw.

The next portion of the treatment consisted of observing video-tapes of children performing jumping and throwing skills with the focus of identifying developmental sequences achieved as compared to the skills described by Roberton and Halverson (1984). For the observations described in each scenario viewed on the video-tape, the subjects were instructed to compare the observed performance with the developmental sequence in Roberton and Halverson (1984), and then to formulate a statement of feedback which would guide the child/performer to a more mature performance of the skill. As in the treatment for the Content Knowledge group, "slow-motion" viewing speed was used if necessary to correctly identify the action performed. The statements of feedback were to be specific to a body component and phase of the skill and be corrective so as to guide the performer to advance toward a more mature developmental level. It was indicated, that for a statement to advance the child's performance, the observation must be accurate to the performance. The statement formulated from the observation must guide the performer by including specific information about the phase of the skill and the component or body part involved. For each skill the subjects formulated statements of feedback which were then analyzed to determine if all components of feedback (corrective, accurate, specific) were incorporated. Discussion on various feedback statements was encouraged, and statements were adjusted to provide all components if they were originally lacking. This treatment did not include observation of children in a "live" setting and the reception of feedback statements by children. This interaction is a critical aspect of determining pedagogical content knowledge, but was beyond the scope of this study. The conclusion for this group focused on the observation and feedback process, and the importance of researching the "critical features" of interest in any activity.

Control Group

Between the pre-test and post-test, the Control Group was involved in the preparation and implementation of an observation assignment. This assignment involved the planning of a session in which the class would observe children playing in a variety of activity settings. The subjects organized five play areas in a university gymnasium. The five settings were designed to encourage the children to manipulate objects (throwing, striking, catching, kicking), balance and move on a variety of apparatus, climb (wall climber), swing (suspended ropes, rings, trapeze), and tumble (mat area). The subjects were also encouraged to speculate about what they may expect to observe. The subjects were instructed to focus on two skills of their choice, although the children were not controlled in their participation (i.e., the children were at free play and were allowed to participate in any way they chose). They were directed by the instructor to examine work or texts on Elementary Physical Education and Motor Development. The subjects then observed children, aged four to six years, at play within the setting for 40 minutes.

During the child observation sessions the instructor of the class and the instructor of the experimental treatment groups were present to answer questions the subjects might have with regard to their assignment. No specific instruction regarding motor skills, observation or feedback was given to the subjects . If subjects had questions regarding a skill, as performed by a child, the instructional response was given through a "Guided Discovery" (Mosston and Ashworth, 1993) technique, encouraging the subject to use their preparatory work to aid in answering the question. The Control Group instructor avoided the specific use of the material and information taught to the experimental groups.

Data Collection

Instruments

Test Video-tape

A video-tape for use in the pre-test and post-test was produced to include four performers demonstrating the standing long jump and forceful overarm throw. The performers were volunteers who consented to perform the skills for the study. Parental consent was also obtained (Appendix C). The performers were two females (aged 6 and 11 years) and three males (aged 6 and 9 years). There were two nine year old males involved in the production: one for the jump and one for the throw. Each performer was video-taped three times to ensure that an entire skill performance was recorded. The video-tape was edited to produce a single performance by each child which was repeated three times with a five second interval between the viewings (i.e., child 1 was seen performing the same jump 3 times, followed by child 2, etc.). Three repetitions of a performance were included as Barrett (1983) and Marks (1990) both recommended that more than one performance should be observed prior to providing feedback in order to ensure that a clear indication of ability has been observed. Therefore, one performance was repeated three times to clarify responses. (The number of observations required for qualitative analysis varies among researchers and authors, however since the same movement was observed, three repetitions were deemed acceptable.) The video-tape was produced to include performances of four children jumping followed by four children throwing. The performances were good examples of developmental sequences. The video-tape was in color with no visual flaws that would interfere with the observation. It was recorded outdoors with no distractive activities, and the angle of view was selected to allow the developmental sequences of each skill to be clearly displayed. The camera was placed perpendicular to the direction of the jump and at a 45 degree angle to the line of the throw (facing the thrower and on the side of the throwing arm).

Subject Questionnaire

Once agreeing to participate in the study, the subjects responded to a questionnaire designed to gather demographic information including age, gender, educational program, program year, physical education training, sport participation, teaching experience, and coaching experience (Appendix D). The subjects were also requested to rate their confidence, competence, and ability to perform analysis of physical skills performed by children.

Pre-test

A three phase testing procedure was used to evaluate the subject's knowledge of a standing long jump and forceful overarm throw performed by children. The written test (phase 1) was designed to determine the subject's knowledge of the developmental sequences of the two skills and was a direct measure of content knowledge. The feedback (phase 2) and observation (phase 3) portions of the pre-test measured the ability of the subjects to provide corrective, accurate, and specific feedback and to accurately observe the skills. The feedback and observation tests were designed to demonstrate the impact of the three treatments on vital aspects of teacher's abilities to formulate feedback after observing a skill performance. The feedback test was a measure of pedagogical content knowledge requiring the integration of the pedagogical processes of skill analysis with specific information about developmental sequences of the throw and jump (content knowledge) related to the child observed. This test required the problem solving skills of what was observed, what was required for improvement, and how to express the desired improvement to identify the direction of the next action based on the child observed. The observation test was not designed as a specific measure of a particular type of knowledge (although it was linked to pedagogical knowledge) but was to identify potential differences in the process of skill analysis which may be related to the treatments received. The goal of the instruction within the treatments was to increase the number of accurate, specific observations and corrective, accurate, and specific feedback statements. The pre-test for each subject resulted in a score of correct responses on the written test plus categorization of the statements for feedback and observation, respectively.

Each group completed the pre-test within their class period under the same, two-day format. The written test was administered first, on a separate day, so that it would not contaminate the feedback and observation tests by drawing the subjects' attention to components or features of the two skills. There was no time limit allocated for the completion of the test so that all subjects would be encouraged to answer the questions honestly and completely. In all cases the test was completed within a twenty minute time frame. Phase 2 and 3 were completed in the next class period for each group (a maximum of forty-eight hours between phase 1 and phases 2/3). The feedback portion of the test was conducted prior to the observation phase, so that the written observation did not influence the statements of feedback by focusing the subject on a component of the skill.

Phase one - content.

The first phase was a written evaluation of content knowledge of developmental sequences of the two skills (Appendix E). Ten four-part questions were designed for this test; five for the jump and five for the throw. Each question described a sequence of the skill and asked whether the subject considered it to be a description of a mature pattern for that skill. Responses available were "yes", "no", or "not sure", of which the subject was to select one. The next portion of the question was related to the first description, in that the subject was given three more descriptions of the same component and phase of the skill and was requested to state whether or not this pattern would appear prior to the development of the movement pattern described by the original statement. The responses available were once again "yes", "no", or "not sure".

The questions were devised using the developmental sequences described in Developing Children - Their Changing Movement: A Guide For Teachers by Roberton and Halverson (1984). A test score for each subject was created based on the number of correct responses for the ten questions (possible total of 40), with the number of "not sure" responses also noted. (This test was developed through two pilot studies described in Appendix F.)

Phase two - feedback.

In the second phase of the pre-test, the subjects viewed video-taped performances of four children demonstrating both a standing long jump and forceful overarm throw. Each video-taped skill was repeated three times at normal speed prior to the subject's response to the questions. Prior to the start of the test, the subjects were informed that the children they would observe had been instructed to "jump as far as you can, taking off and landing on two feet". The subjects were requested to provide up to three statements of feedback which would help the child improve on her/his next performance of the skill (Appendix G). The subjects were also instructed to watch all three of the performances by each child before recording their feedback statements. The subjects then viewed the three repetitions of the first performance of the jump, and wrote the statements of feedback. The researcher then requested that the subjects observe the second jump performance. This format was followed for the third and fourth performers on the video-tape. The subjects were not allowed to return to the previous trial responses once the next observation was initiated.

Immediately following the response to the fourth jumper, the subjects observed the performances of the first throw. Prior to the first performance, the subjects were informed that the children on the video-tape had been instructed to "throw the ball overarm as far as they could". The performances of the throw were then viewed using the same format as for the jump. Following each skill performance in this phase, the subjects were provided 75 seconds to respond to the question.

The feedback statements were classified based on the specificity, accuracy and corrective nature of the statements (Nielsen & Beauchamp, 1991). Statements were classified in four ways:

1. Corrective, accurate, specific. The statement was to be corrective in nature, accurate to the specific performance, and specific to body component and skill phase (e.g., Jump - "Pull your knees up while you are in the air." "Lean forward more and bend your knees more on takeoff." Throw - "Step forward with your left foot." "Twist your body to the right more in preparation to throw.").
2. General. The statement was corrective in nature, accurate to the performance but not specific to body component or phase (e.g., "Pull your legs up." "Can you bend your knees?" Throw - "Take a step as you throw." "Bring the ball behind your head.").
3. Inaccurate. The statement was corrective in nature but inaccurate in response to the performance presented (e.g., Jump - "Lean forward on the jump." "Bend your knees more before you take off." Throw -"Step forward with your opposite foot." "Lead with your elbow."). (In each of these scenarios, the child had a mature pattern in the aspect identified, the statement did not identify a change in the present performance, or was in error for advancement of the skill.)
4. Other. The statement provided reinforcement, description, or was peripheral to the question (e.g., Jump – "Good effort". "Good distance."

Throw - "Good job, everything looks great." "Keep throwing like a pitcher in the major leagues.").

Each statement of feedback was categorized for a possible total of 24 (12 for the jump and 12 for the throw) responses per subject (Appendix H). (Not all subjects included three statements of feedback for each skill performance observed.) The statements were classified by two trained observers, independently. The observers were unaware of the group to which each subject belonged while classifying the statements. Classification differences were then discussed and resolved through consensus (Nielsen & Beauchamp, 1991). The statements were not evaluated with regard to the comprehension level of the observed child as this was not a dimension of the present study, although it would be considered an aspect of the appropriateness of the feedback, and an integral part of pedagogical content knowledge. Ultimately, the feedback statements would represent the most accurate measurement of pedagogical content knowledge levels for each group as the feedback should blend knowledge of developmental sequences (content) with the performance observed to provide advancement of the specific learner. The feedback statement was a measurement of the problem solving ability of the subjects to determine the direction for improvement. How that direction would be delivered (directly to the child, changing the task, changing the environment) was not an aspect of this test.

Phase three - observation.

In the third phase, the subjects repeated the observation of the video-taped performances. The format described in phase two was followed for the third phase of the pre-test, i.e., the subjects observed the three repetitions of the skill, and were then allotted 90 seconds to describe the skill they had observed. The time designated for each phase of the pre-test was found to be substantial for all of the subjects to complete the task. For each skill performance, the subjects were asked to provide a written description of the skill observed (Appendix I).

Through a random sample of the data, four classifications for categorizing the statements of description were identified and agreed upon by the two observers.

1. Accurate, specific. Specific to phase and body component and accurate to the performance observed (e.g., Jump - "Her knees only bend slightly on landing." "Extends arms partially overhead - could be more - on take off." Throw - "Steps forward with the left foot as he throws." "Elbow is slightly in front of the arm during the forward motion.").
2. General. A general description which does not identify phase and/or body component but was determined to be accurate (e.g., Jump - "She was leaning nicely forward." "The boy had his feet positioned correctly for the jump." Throw - "Stepped forward." "Arm is 'cocked' behind head.").
3. Inaccurate. Specific or general statements that inaccurately described the skill performance presented (e.g., Jump - "His arms did a little circle as he landed." "The child only bends at the hips in flight." Throw - "Doesn't follow through." "Leaned back as he threw.").

4. Other. The statement correctly described an aspect of the skill, but was not critical to the performance, was evaluative, or referred to effort (e.g., the statement referred to the child's point of focus, or to an aspect of the skill which would not impact on the outcome, was motivational, or was a judgment. Jump - "Loses balance on landing." "Pumps arms back and forth." "Good arm swing." "The girl's jump was fairly correct." Throw - "Throws right handed." "She should bring the ball back further." "Good pitch.").

There was no limit to the number of statements which could be included in the description. The observation statements were categorized for each subject selected at random (Appendix J) by two trained observers. The group to which each subject belonged was not available to the observers during the process of categorization. Discrepancies in categorization of the statements were discussed and resolved through consensus.

Following the pre-test, the three experimental groups were presented with the various treatment programs during their regular class periods. (See "Treatment" for more details.)

Post-test

Each group participated in a post-test during a regular class period within one week of the completion of their treatment package. The post-test included the same phases, procedures and video-taped performances as the pre-test. Following the post-test, CK, PK, and the Control Group received instruction on the components of the treatment that their group did not receive. The subjects also completed a second questionnaire in which they repeated their assessment of their confidence, awareness, and competence in analyzing children in a physical activity setting (Appendix K).

Validity

Internal Validity

The design selected provided controls for threats to internal validity. If the groups were determined to be equivalent following the pre-test, the design provided control for history, maturation, testing and instrumentation, "in that the difference for the experimental group between the pre-test and post-test . . . cannot be explained by the main effects of these variables such as would be found affecting both the experimental and control group" (Campbell & Stanley, 1969, p. 48). Therefore, the differences found between the pre-test and post-test should be a consequence of the differing treatments. Maturation would be reduced with the short length of the study (maximum of 17 days between pre-test and post-test). Although the individual subjects were not assigned to groups randomly, the groups were randomly assigned to treatments or control, thereby reducing the chance of differences appearing due to regression rather than treatment (i.e., the groups were not assigned to treatment/control due to their extreme scores). The control group design was used to determine the effects of the tests/instrumentation used in the testing procedures. If the control group remained unchanged throughout the length of the study, it could be assumed that maturation or other aspects of the course did not contribute to changes observed within the experimental groups. Following the scoring of the pre-test, the four groups were determined to be equivalent.

External Validity

External validity considers the extent to which the results of a study are generalizable to other individuals, or situations. According to Campbell and Stanley (1969), the threats to external validity within the design used included: interaction effect of testing, interaction of selection bias and experimental variables, reactive arrangements, and multiple-treatment interference. With the use of a control group, interactive effects of testing were controlled, as was the interaction of selection bias to experimental variables. This study did not involve the delivery of multiple treatments to the same subjects and, therefore, multiple treatment interference was not considered to be a threat to external validity. Generalizability was reduced, however, and limited to similar groups, under similar procedures due to the reactive effects of experimental arrangements.

Measurement Validity

Measurement validity is the degree to which the measurements truly measure the actual construct. The written test on the content knowledge component of fundamental motor sequences was designed and tested through a pilot study (Appendix E). The testing procedure and evaluation of statements used in the feedback test were consistent with a classification system used by Nielsen and Beauchamp (1991). Kernoble and Carlton (1992) also found these types of statements to be most effective in improving throwing action. All of the statements were categorized by two observers with 100% agreement being obtained on each statement's categorization. The same procedure was followed for the observation test, with a category framework being developed through random sample of the data. If disagreements were determined, the two observers resolved them through discussion and consensus. Prior to the inspection of the data, the video-taped skills were observed and analyzed by two experts, who, through consensus, formulated criterion descriptions for each skill (Appendix L). Through the process of consensus the measurements of the testing procedures were deemed to be valid.

Analysis

An analysis of variance (ANOVA) on the mean change in scores from the pre-test to post-test was completed for each variable measured (Finn, 1988). The change in score was calculated by subtracting the number of responses in each variable category in the pre-test from the corresponding number of responses in the post-test. Analysis of Variance is a model by which to compare "differences in the means of a variable across groups of observations (Iverson & Norpoth, 1987, p. 7). This method was used to determine whether the "differences in the sample means are random variations that occur by chance or whether there are systematic differences between the means" (Iverson & Norpoth, 1987, p. 7). In this study, ANOVA was used to determine if differences in the change in scores from the pre-test to the post-test for each test variable occurred between groups.

If differences occurred between groups in the ANOVA, a Newman-Keuls Post-Hoc procedure was completed to determine between which groups the differences occurred. This type of test has a liberal level of stringency as compared to other post-hoc tests. When compared to the Duncan procedure, "on the average, a larger difference between two means ....is required for statistical significance under the Newman-Keuls procedure" (Winer, 1962, p. 86). A liberal test was used to determine differences among groups as this was an exploratory study to address teaching methods based on a model of teacher knowledge.

These procedures were calculated by the use of SPSS 6.0 statistical software (Noruis, 1993).

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter a comparison of the abilities of groups of similar subjects to use the skills of motor skill analysis and provision of feedback when receiving no instruction, pedagogical knowledge only, content knowledge only, or pedagogical content knowledge will be completed.

Subject Demographics

100 students enrolled in a required physical education course for elementary school teachers at the University of Alberta volunteered to participate in this study. The students were enrolled in four sections of the course and each intact section participated as one of the four groups within the study. Table 3 provides a synopsis of the number of subjects in each section of the course including the mean age and gender of the subjects, and the degree programs in which the subjects were enrolled. As can be noted, there were 77 female and 23 male subjects with a mean age of 22.29 years. The vast majority (87%) of the subjects were education students pursuing a degree in elementary school education.

Table 3

Subject Demographics

Treatment Group	Number Of Subjects	Mean Age (yrs.) (SD)	Gender (females/males)	Degree Sought
PK	25	20.44 (2.14)	19/6	22 Education 2 Physical Education 1 other
CK	26	22.65 (4.69)	22/4	23 Education 2 Physical Education 1 other
PCK	23	23.52 (6.06)	19/4	20 Education 2 Physical Education 1 other
Control	26	22.62 (7.61)	17/9	22 Education 4 Physical Education
Total	100	22.29 (5.54)	77/23	87 Education 10 Physical Education 3 other

To determine equivalence among the groups, an analysis of variance was conducted on the pre-test results for each of the testing procedures for the jump and throw (i.e., "correct" responses in the content test, "accurate, specific" statements for the observation test, and "corrective, accurate, specific" statements for the feedback test). The results of the ANOVA's indicate no significant differences among the four groups on the pre-test scores (Table 4). The groups were equivalent in their responses prior to the treatment.

Table 4

Equivalency Of Groups: Pre-Test ANOVA (Groups X Test Scores)

Pre-test phases for each skill	Degrees Of Freedom	F-ratio	p-Value
Knowledge score - jump	3, 99	0.6128	0.6083
Knowledge score – throw	3, 99	0.8333	0.4788
Observation - "as" statements – jump	3, 99	0.7110	0.5477
Observation - "as" statements – throw	3, 99	1.3327	0.2683
Feedback - "cas" statements – jump	3, 99	1.5814	0.1989
Feedback - "cas" statements – throw	3, 99	1.8949	0.1356

Note:

"as" - Accurate, specific statements

"cas" - Corrective, accurate, specific statements

† $p < .05$ one-tailed, * $p < .05$ two-tailed

Results

Statistical analysis of each component incorporated an analysis of variance of the change in score from pre-test to post-test to determine differences between groups. A Newman-Keuls Post-hoc test was applied to indicate the location of the significant differences. Since there was no significant differences on the pre-test scores between groups, concern regarding observed changes in scores was neutralized, and ceiling effects did not result. The results of the study are presented in three categories: Content, Observation, Feedback.

Content

The analysis of variance of the change in scores of the Content test are presented in Table 5. This statistical analysis compared the differences among groups in the change in score from the pre-test to the post-test. Significant differences among groups were found in the change in the mean number of "correct" responses from the pre-test to the post-test for both the jump and throw portions of the test. There was also a significant difference noted in the mean change in the number of "not sure" responses for the throw portion.

Table 5

Content ANOVA Results: Group X Change in Score

	Degrees Of Freedom	F-Ratio	p-Value
Jump - Correct	3 ,96	5.7478 [†][a]	0.0012
Throw - Correct	3, 96	14.3305 [†][a]	0.0000
Jump "Not Sure"	3, 96	1.0686	0.3662
Throw "Not Sure"	3, 96	3.1617 [*][b]	0.0281

Note:

[a] Newman-Keuls Test: significant difference between PCK and PK, PCK and Control, CK and PK and CK and Control.

[b] Newman-Keuls Test: significant difference between Control and CK

[†] p < .05 one-tailed, [*] p < .05 two-tailed

The post-hoc tests indicated that PCK and CK groups both showed a significant positive change in the number of "correct" responses from the pre-test to post-test, for both the jump and the throw tests when compared with the PK and Control groups (Table 6, Figure 1, 2). All groups showed a decrease in the number of "not sure" responses, but this was only significant for the CK group compared to the Control group in the throw only (Table 6, Figure 3). Since a significant difference was found in the number of "correct" responses, there would be a change in other categories to allow for that change. It is noted that the majority of the change came from a decrease in the number of "not sure" responses. Since CK had the greatest change in "correct" responses, the change in the number of "not sure" responses was also significant.

Table 6

Summary Of Content Score For Each Group: Mean (Standard Deviation)

Question Response	PK		CK		PCK		C	
	pre	post	pre	post	pre	post	Pre	post
Jump "correct"	11.00 (2.97)	11.80 (3.03)	10.50 (3.15)	14.35 [a] (4.22)	9.91 (2.76)	12.74 [a] (3.18)	10.19 (2.82)	11.12 (2.93)
Jump "not sure"	2.16 (2.78)	1.08 (1.87)	3.04 (2.91)	1.00 (1.36)	1.65 (1.67)	0.44 (0.79)	2.19 (2.24)	1.08 (1.55)
Throw "correct"	10.6 (2.55)	10.00 (2.60)	9.77 (3.13)	13.73 [a] (4.36)	9.65 (2.39)	12.22 [a] (3.94)	10.65 (3.72)	9.31 (3.22)
Throw "not sure"	2.52 (3.43)	1.72 (2.49)	3.89 (3.62)	1.31 [b] (2.15)	2.09 (1.99)	0.44 (1.12)	2.39 (2.90)	1.96 (2.93)

Note:

[a] Newman-Keuls Test: significant difference between PCK and PK, PCK and Control, CK and PK and CK and Control.

[b] Newman-Keuls Test: significant difference between Control and CK

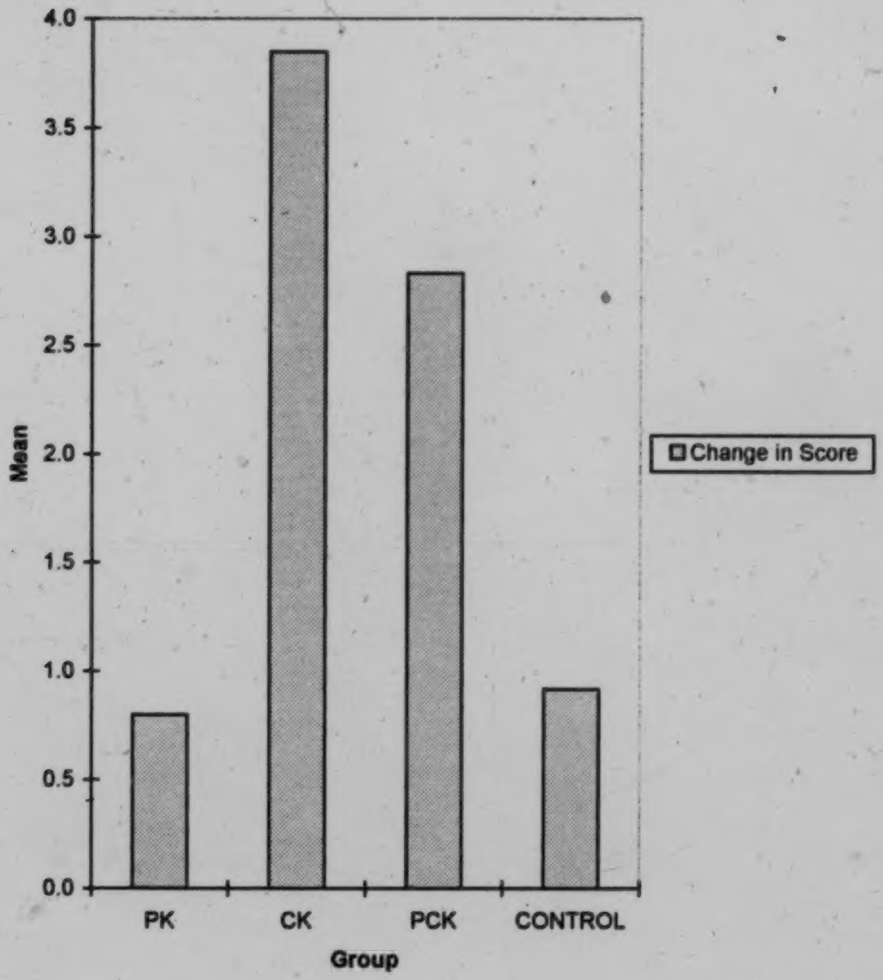

Figure 1. Mean change in the number of "Correct" responses for the jump portion of the Content Test for each group.

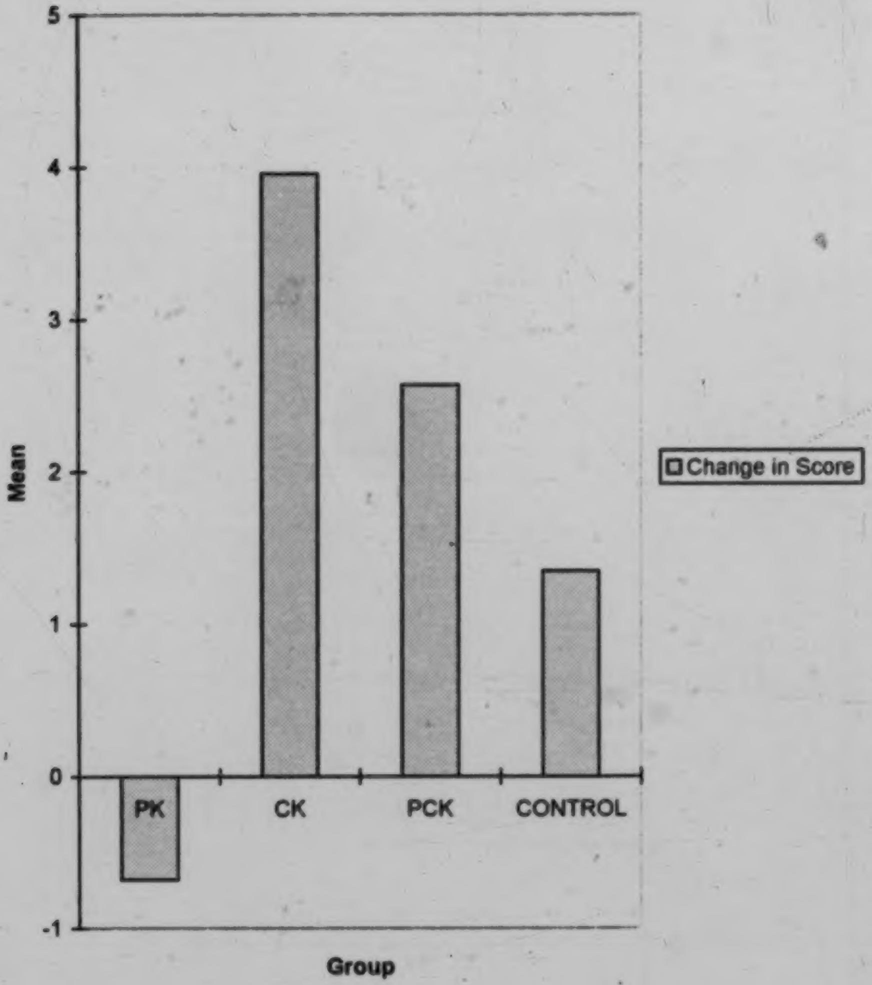

Figure 2. Mean change in the number of "Correct" responses for the throw portion of the Content Test for each group.

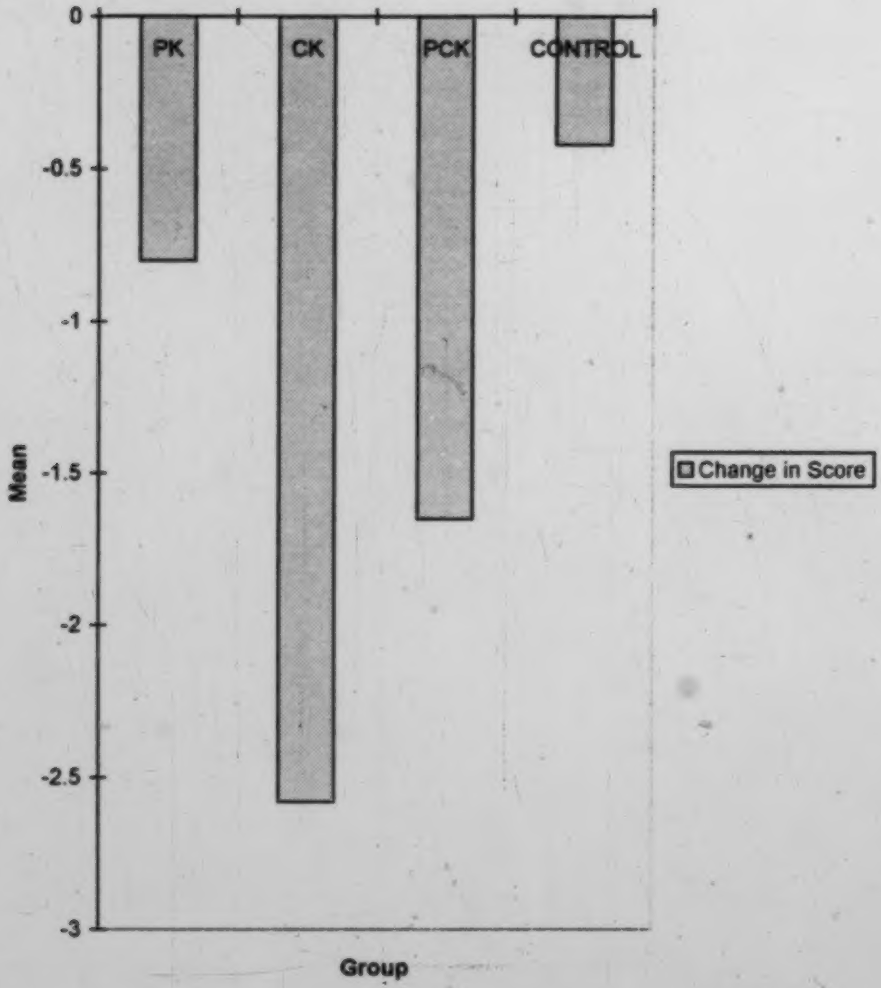

Figure 3. Mean change in the number of "Not Sure" responses for the throw portion of the Content Test for each group.

The respective treatments for PCK and CK included information on developmental sequences for the jump and throw. The treatments resulted in an increased number of "correct" responses by these groups from the pre-test to the post-test for both skills, while both groups decreased the mean number of "not sure" responses from pre- to post-test for both skills (Table 6). However, the only one significant difference noted among groups in the decreased "not sure" response frequencies was between the Control group and the CK group for the throwing skill. This was probably due to the decrease in the number of "not sure" responses by all groups from the pre-test to the post-test. This pattern was observed for both skills (i.e., the mean number of "not sure" responses from pre-test to post-test declined for all four groups). This decrease was not significant among all groups, however, but the pattern is interesting, indicating a possible increase in confidence in responding to the questions in the post-test by all subjects.

Observation

The ANOVA results for the observation test evaluated the change in the mean number of "accurate, specific", "general", "inaccurate" and "other" statements generated in the pre-test and post-test for the jump and the throw.

In the jump, a significant difference was observed between groups in the change in "accurate specific" responses, with the CK group differing from both the Control and PK groups (Table 7, Fig. 4). Although the PCK group increased the mean number of "accurate, specific" responses (Table 8, Fig. 4), it showed a significant increase in responses when compared with the Control group only

(Table 7, Fig. 4). Within the observation tests the PCK group most frequently identified the landing phase (42.95% of responses) (Fig. 5) while the CK group identified the flight phase most often (40.44%) (Fig. 6) (Appendix M; Table M1). In the pre-test all groups reported the majority of the "accurate, specific" statements with regard to the landing phase of the jump, followed by the preparation/takeoff phase (Fig. 7) and then the flight phase (Fig. 6) (with the exception of PK, which identified flight responses second, and preparation/takeoff third) (Appendix M; Table M1). The CK and PCK groups identified greater variety in phases of the skills identified in the post test (Fig. 5, 6, 7), with a marked increase by both groups in accurately identifying the flight phase. The treatments administered to the CK and PCK groups appeared to influence the ability of both groups to focus attention to different aspects of the skill.

Analysis of the jump also showed a significant difference between groups in the change in the number of "inaccurate" statements from pre-test to post-test (Table 7). The post-hoc test identified the differences as occurring between the PCK group and both the PK and Control groups, as well as between the CK group and both PK and Control. There was no significant difference between PCK and CK. In both of these cases the mean number of inaccurate statements made by PCK and CK increased from the pre-test period to post-test (Table 8, Fig. 8). The PCK and CK groups increased their ability to accurately observe more points of the skill performances in the jump but, both groups also increased the number of "inaccurate" statements regarding the performances.

Table 7

Jump Observation ANOVA Results: Group X Change in the Number Of Statements

Statements	Degrees Of Freedom	F-Ratio	p-Value
Accurate, Specific	3, 96	7.5620[†][a]	0.0001
General	3, 96	1.5201	0.2142
Inaccurate	3, 96	6.2015[†][b]	0.0007
Other	3, 96	1.4878	0.2227

Note:

[a] Newman-Keuls Test: significant difference between PCK and Control; CK and PK; CK and Control.

[b] Newman-Keuls Test: significant difference between PCK and PK; PCK and Control; CK and PK; CK and Control.

[†] $p < .05$ one-tailed, [*] $p < .05$ two-tailed

Table 8

Summary Of Jump Observation Statements For Each Group: Mean (Standard Deviation)

Statements	PK		CK		PCK		CONTROL	
	pre	post	pre	post	pre	post	pre	post
Accurate Specific	4.36 (3.33)	3.96 (2.37)	3.50 (2.63)	7.04[a] (3.24)	4.13 (2.72)	6.48[a] (4.33)	3.39 (2.59)	4.19 (3.05)
General	4.40 (2.74)	4.20 (2.80)	3.54 (2.97)	3.27 (2.09)	3.09 (1.88)	4.39 (2.25)	4.08 (2.73)	4.00 (2.83)
Inaccurate	4.12 (1.97)	3.88 (2.52)	2.85 (1.78)	4.85[b] (2.66)	2.83 (1.56)	4.52[b] (1.97)	2.77 (1.45)	3.19 (1.30)
Other	6.04 (4.29)	5.16 (2.21)	6.23 (3.89)	3.27 (2.69)	7.48 (4.80)	3.44 (2.50)	6.77 (5.63)	4.92 (2.65)

Note:

[a] Newman-Keuls Test: significant difference between PCK and Control; CK and PK; CK and Control.

[b] Newman-Keuls Test: significant difference between PCK and PK; PCK and Control; CK and PK; CK and Control.

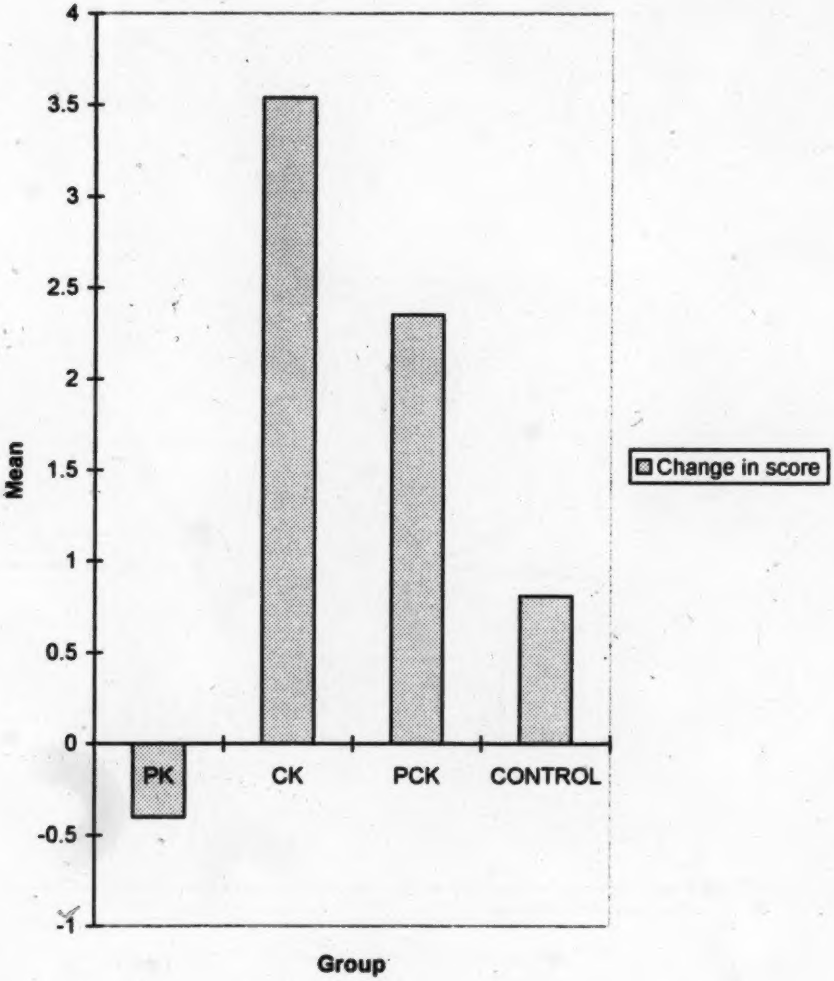

Figure 4. Mean change in the number of "accurate, specific" statements in the jump portion of the observation test for each group.

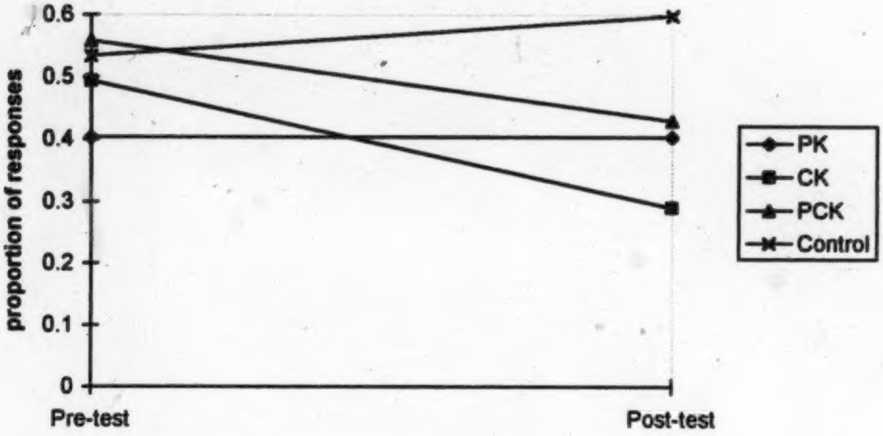

Figure 5. Proportion of "accurate, specific" responses in jump observation tests identifying the landing phase.

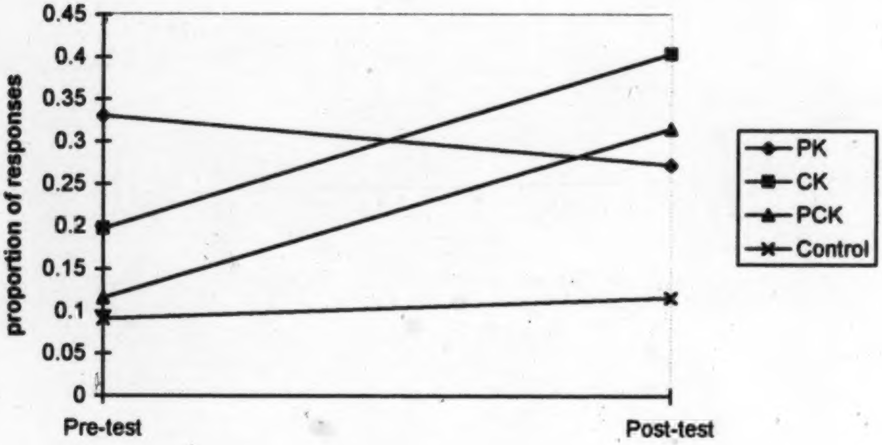

Figure 6. Proportion of "accurate, specific" responses in jump observation tests identifying the flight phase.

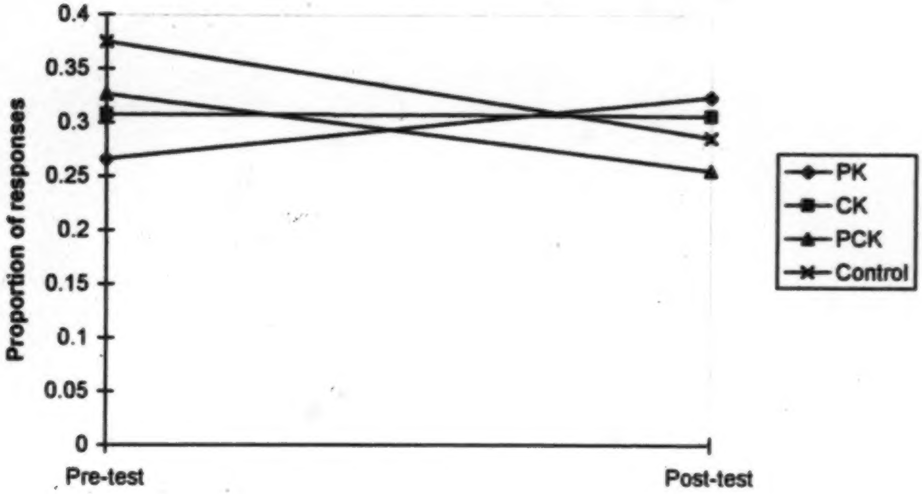

Figure 7. Proportion of "accurate, specific" responses in the jump observation test identifying the preparation and takeoff phase.

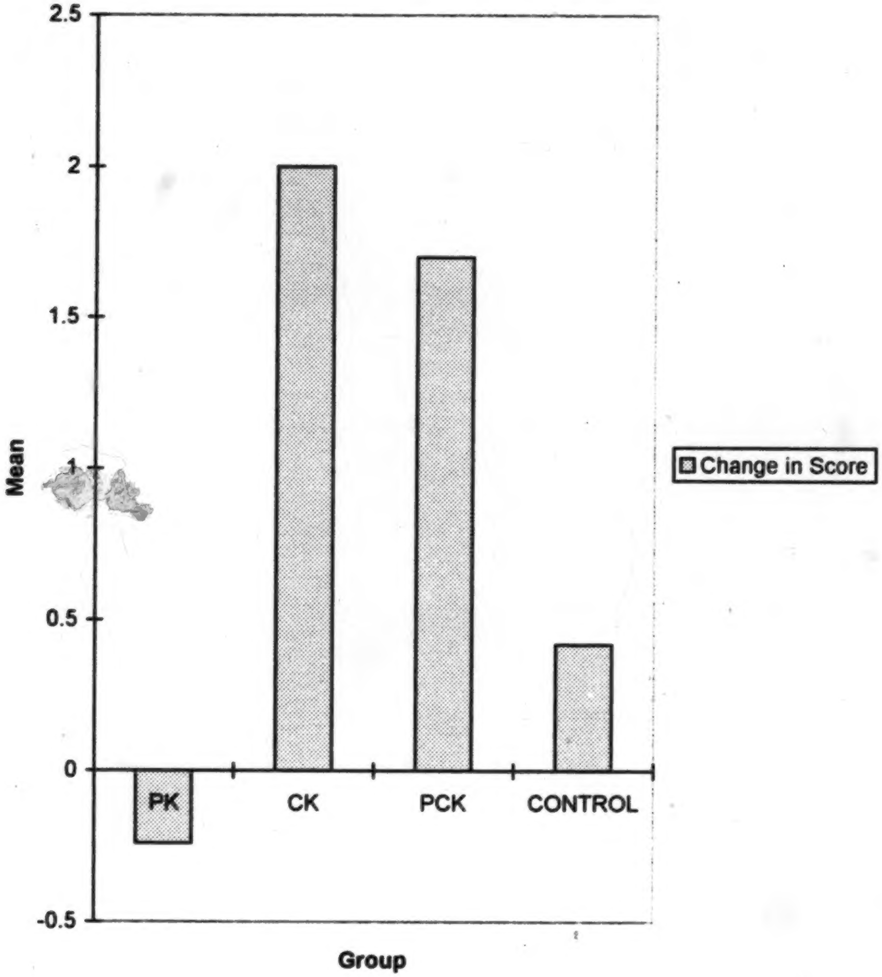

Figure 8. Mean change in the number of “inaccurate” statements in the jump portion of the observation test for each group.

The ANOVA of the observations on the throw indicated a significant difference in the "accurate, specific" observations only (Table 9). There were no differences among groups in the change in the number of statements for the "general", "inaccurate" and "other" categories between the pre-test and post-test (Table 9). The post-hoc test identified the differences in "accurate, specific" statements between PCK and both PK and Control, and also between CK and both PK and Control. PCK and CK showed a mean increase in the number of "accurate, specific" statements from the pre-test to the post-test (Table 10, Fig. 9), while the other groups did not change substantially. Within these responses, the force production phase of the throw was identified most frequently (61.60% and 65.61% for PCK and CK, respectively) (Fig. 10) (Appendix M; Table M2). The force production phase of the throw was most frequently identified by all groups in both the pre- and post- test (Fig. 10). The stepping action was the component within this phase which was identified the most often. This is consistent with the findings by Walkwitz and Lee (1992a), where the stepping action was most often noted by the experienced and novice teachers. Both the PCK and CK groups increased the percentage of statements identifying the preparation phase (Fig. 11), however, while decreasing the percentage of statements identifying the follow-through (Fig. 12) (Appendix M, Table M2). Again the performance of the CK and PCK groups was superior to the PK and Control group but not different from each other.

Table 9

Throw Observation ANOVA Results: Group X Change in the Number of Statements

Statements	Degrees Of Freedom	F-Ratio	p-Value
Accurate, Specific	3, 96	9.4459[†][a]	0.0000
General	3, 96	1.5457	0.2077
Inaccurate	3, 96	0.4605	0.7105
Other	3, 96	1.3724	0.2559

Note:

[a] Newman-Keuls Test: significant difference between PCK and PK; PCK and Control; CK and PK; CK and Control.

[†] $p < .05$ one-tailed, [*] $p < .05$ two-tailed

Table 10

Summary Of Throw Observation Statements For Each Group: Mean (Standard Deviation)

Statements	PK		CK		PCK		CONTROL	
	pre	post	Pre	Post	pre	post	pre	post
Accurate Specific	4.12	3.68	3.50	6.04[a]	2.74	5.44[a]	3.12	3.85
	(2.93)	(2.56)	(2.34)	(1.92)	(2.67)	(3.06)	(2.09)	(2.72)
General	4.88	5.12	5.04	3.58	4.48	4.35	4.42	4.00
	(2.62)	(3.02)	(2.60)	(1.92)	(2.06)	(2.37)	(2.42)	(2.71)
Inaccurate	4.04	4.32	4.27	3.81	3.65	3.22	3.42	3.12
	(2.15)	(3.02)	(2.26)	(1.81)	(2.10)	(1.46)	(2.23)	(1.75)
Other	2.88	2.16	2.92	1.54	3.65	1.52	4.27	3.50
	(2.17)	(2.10)	(2.17)	(1.39)	(3.14)	(1.88)	(2.49)	(3.22)

Note:

[a] Newman-Keuls Test: significant difference between PCK and PK; PCK and Control; CK and PK; CK and Control.

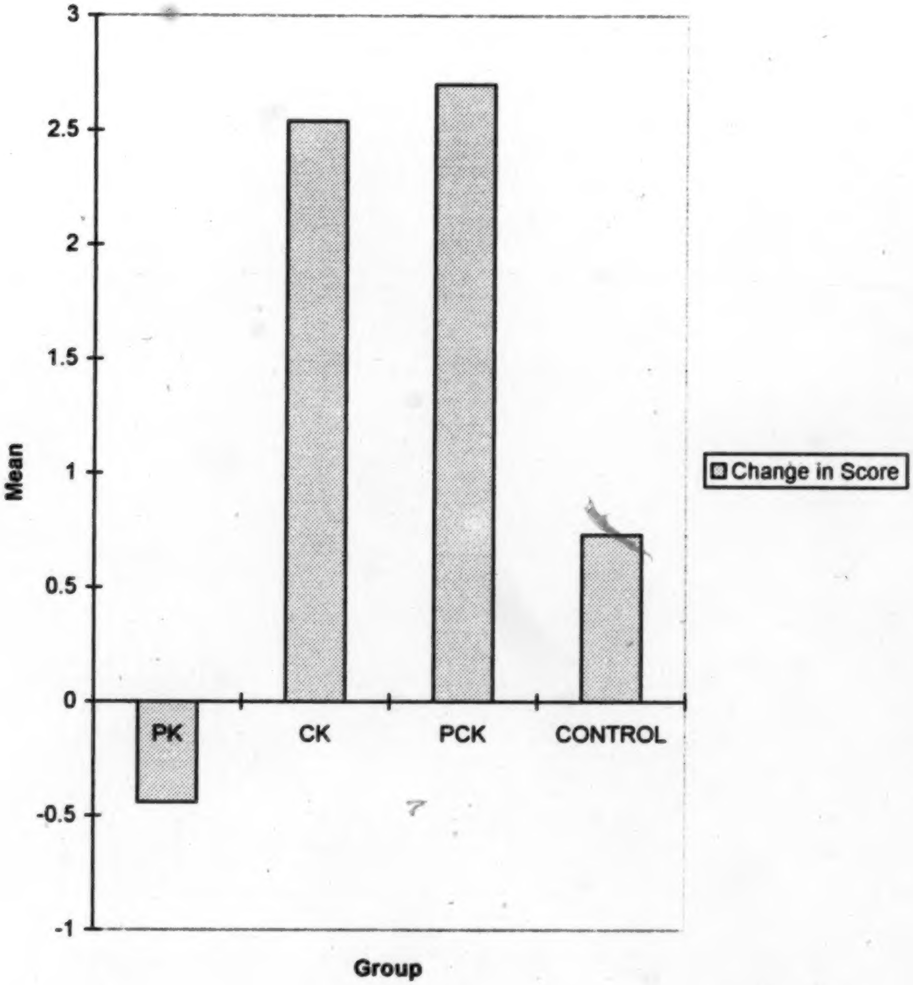

Figure 9. Mean change in the number of "accurate, specific" statements in the throw portion of the observation test for each group.

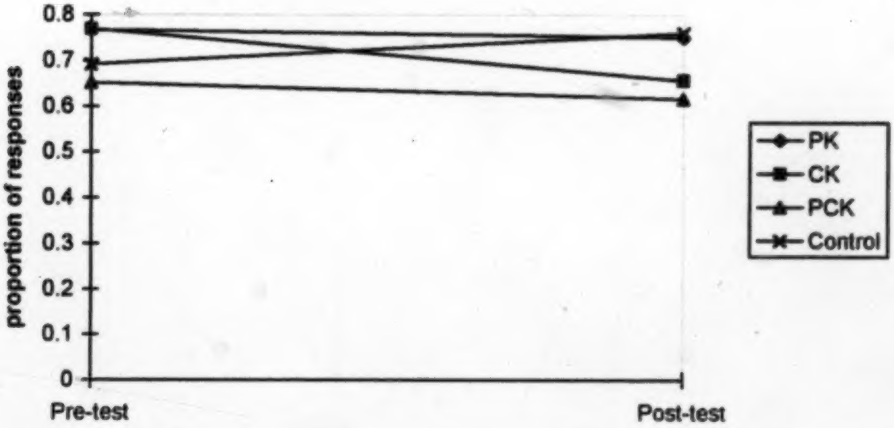

Figure 10. Proportion of "accurate, specific" responses in throw observation tests identifying the force production phase.

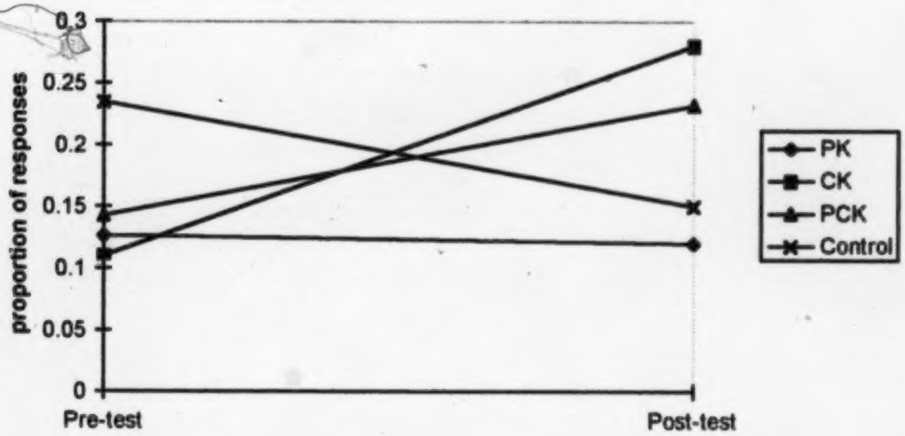

Figure 11. Proportion of "accurate, specific" responses in throw observation tests identifying the preparation phase.

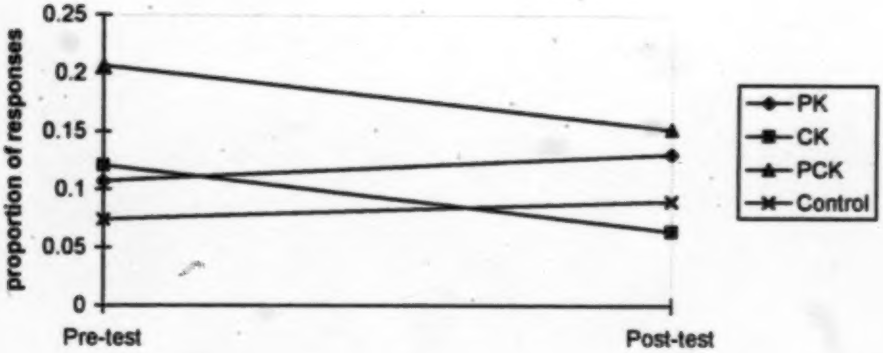

Figure 12. Proportion of "accurate, specific" responses in throw observation tests identifying the follow-through phase.

Like the Content test, the Observation test showed that both the PCK and CK groups benefited from their respective treatments in their ability to accurately describe the skills observed. Examining the summary tables (Table 8 and 10), an increase in the number of "accurate, specific" statements can be noted, however the changes in the other categories were not consistent. Despite general observation training, the PK group did not appear to benefit in the ability to observe a physical activity performance without the specific knowledge of the skills to be observed. This trend is consistent with studies completed by Arend and Higgins (1976), Brown (1982), Robb (1972), and McPherson (1987).

With the increase in the number of "accurate, specific" observations by the PCK and CK groups, it would be expected to see a decline in the number of statements in the other categories. This did not occur for any group, indicating that although two treatment groups (PCK and CK) were able to more accurately observe and describe the skills they witnessed, no group reduced the inaccuracies in their observations or the tendency to describe the skill in general terms. PCK and CK actually increased the number of inaccurate statements. This increase may have resulted from the assumption by the subjects that they should "know" more about the skill because of the treatments they had received, and that they interpreted movements as occurring because of their increased knowledge not because of actual observations. This finding was consistent with a study by Feltovich, Spiro, and Coulson (1989) where medical students demonstrated a gain in knowledge of diseases without a decline in their belief of myths and misnomers in the same diseases.

Feedback

For the jump, ANOVA results indicated a significant difference was found in the "corrective, accurate, specific" category of responses (Table 11), with the differences appearing between PCK and the other three groups, but also between CK and both PK and Control. Both the PCK and CK groups increased the mean number of statements in this category from the pre-test and post-test (Table 12, Fig. 13). However, the increase observed for the PCK group was significantly different than that observed in the CK group. Within the jump, the CK group was able to convert the knowledge gained in the treatment to generate an increased number of "corrective, accurate, specific" statements of feedback which was significant in comparison to the PK and Control groups.

Table 11

Jump Feedback ANOVA Results: Group X Change in the Number of Statements

Statements	Degrees Of Freedom	F-Ratio	p-Value
Corrective, Accurate, Specific	3, 96	17.3998[†][a]	0.0000
General	3, 96	5.3969[†][b]	0.0018
Inaccurate	3, 96	1.5818	0.1988
Other	3, 96	0.8881	0.4502

Note:

[a] Newman-Keuls Test: significant difference between PCK and CK; PCK and PK; PCK and Control; CK and PK; CK and Control.

[b] Newman-Keuls Test: significant difference between PCK and CK; PCK and PK; PCK and Control.

[†] $p < .05$ one-tailed, [*] $p < .05$ two-tailed

For the PCK group, the attention to specific jump phases was almost equivalent with 30% of the responses identifying the preparation/takeoff phase (Fig. 14), 33% for the flight phase (Fig. 15), and 37% for the landing phase (Fig. 16) (Appendix M; Table M3). In the pre-test, the preparation/takeoff and landing phases were identified most often (37% and 46%, respectively) (Fig. 14, and 16). There was a mild decrease in the number of responses identifying these phases between the pre-test and post-test, with a slight increase in the identification in the flight phase in the post-test for the PCK group (Fig. 15). The increase in correctly identifying the flight phase was also observed in the post-test of the Observation component for the PCK group. The CK group identified the flight phase most often (56%) (Fig. 15) followed by the preparation/takeoff phase (34%) (Fig. 14) within the post-test responses. This was a major shift from the pre-test where 60% of the "corrective, accurate, specific" statements related to the preparation/takeoff phase (Fig. 14). Although the PK group did not significantly change the number of statements within this category from the pre-test to the post-test, the phases identified were altered. In the pre-test, the PK group identified the preparation/takeoff phase in 41% of the "corrective, accurate, specific" statements (Fig. 14), the landing phase in 36% of the responses (Fig. 16) and the flight phase in 23% of the responses (Fig. 15). In the post-test, the responses indicated the three phases on a more even basis with 33%, 32% and 35% identifying the preparation/takeoff, flight and landing phases, respectively (Fig. 14, 15, &16). This reflected a shift in the focus of the subjects in the three treatment groups to all phases of the skill rather than a dominant pre-test focus on the preparation and take-off of the jump (Figure 14, 15, & 16).

Also noted in the assessment of the jump was the significant difference between groups in the "general" category of statements (Table 11). The Newman-Keuls test identified the difference between PCK and the other three groups, with the PCK group decreasing the number of responses in this category from the pre-test to post-test (Table 12, Fig. 17). This also supports the increase in responses in the "corrective, accurate, specific" category since the number of responses allowed within the testing procedure was limited to a maximum of three. Therefore, an increase in one category could result in a decrease within another category of responses if subjects were using the maximum number of responses allowed in both the pre- and post-tests.

The feedback statements did not evaluate the ability of the subjects to deliver direction to children on how to improve and therefore did not evaluate all aspects of pedagogical content knowledge. The difference observed between CK and PCK, or lack of it, may have changed if the study had expanded the scope beyond simulated activities.

Table 12

Summary Of Jump Feedback Statements For Each Group: Mean (Standard Deviation)

Statements	PK		CK		PCK		CONTROL	
	pre	post	pre	Post	pre	post	pre	post
Corrective Accurate Specific	2.44 (1.58)	2.28 (1.72)	2.12 (1.31)	4.00[a] (1.92)	1.52 (1.47)	4.96[a] (2.46)	2.15 (1.59)	1.81 (1.17)
General	2.24 (1.59)	2.28 (1.65)	2.85 (1.62)	2.62 (1.45)	3.35 (1.53)	1.83[b] (1.90)	2.39 (1.96)	3.12 (1.75)
Inaccurate	2.76 (1.30)	3.08 (1.73)	2.23 (1.34)	2.27 (1.69)	2.70 (1.66)	1.87 (1.14)	2.39 (1.90)	2.15 (1.62)
Other	1.24 (1.67)	1.12 (1.13)	1.46 (1.61)	1.08 (1.92)	1.74 (1.45)	0.57 (0.99)	1.39 (1.88)	1.35 (1.44)

Note:

[a] Newman-Keuls Test: significant difference between PCK and CK; PCK and PK; PCK and Control; CK and PK; CK and Control.

[b] Newman-Keuls Test: significant difference between PCK and CK; PCK and PK; PCK and Control.

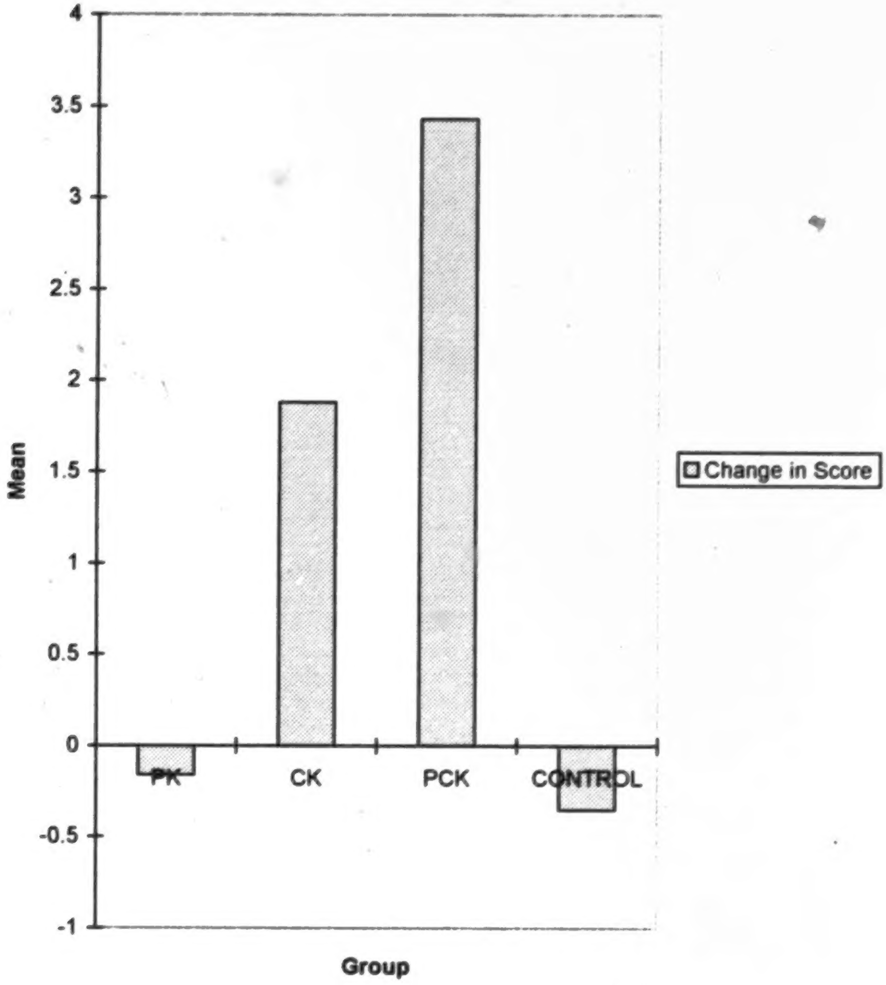

Figure 13. Mean change in the number of "corrective, accurate, specific" feedback statements for the jump for each group.

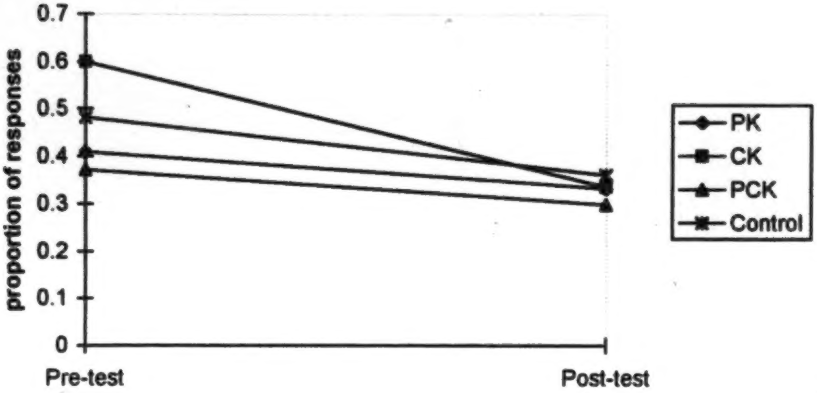

Figure 14. Proportion of "corrective, accurate, specific" responses in jump feedback tests identifying the preparation/takeoff phase.

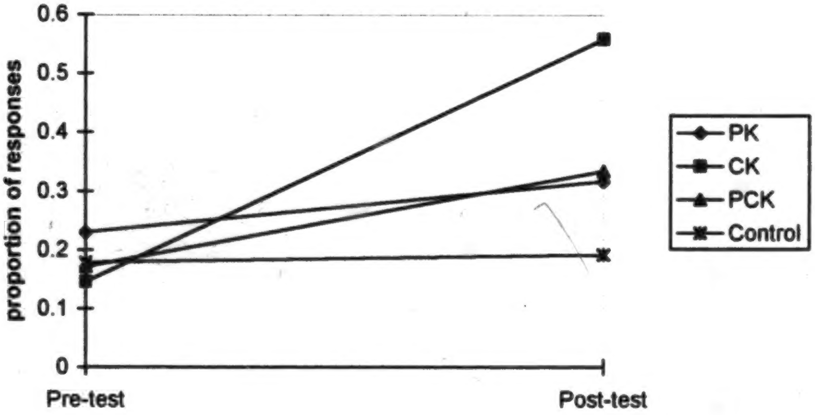

Figure 15. Proportion of "corrective, accurate, specific" responses in jump feedback tests identifying the flight phase.

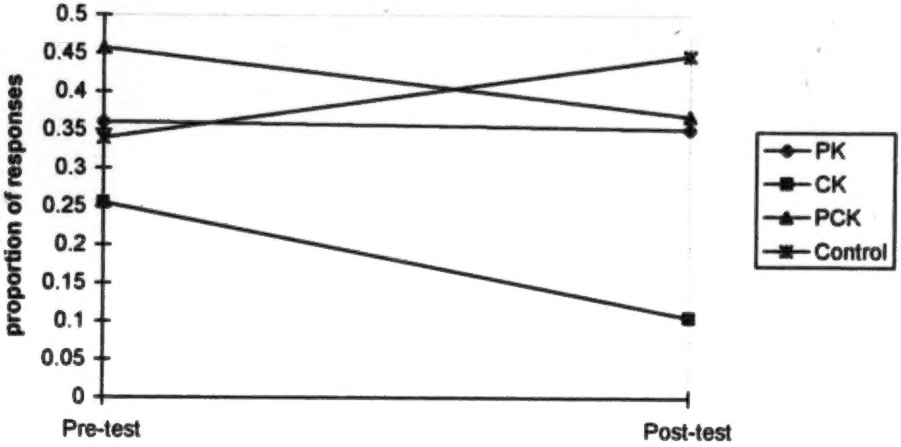

Figure 16. Proportion of "corrective, accurate, specific" responses in jump feedback tests identifying the landing phase.

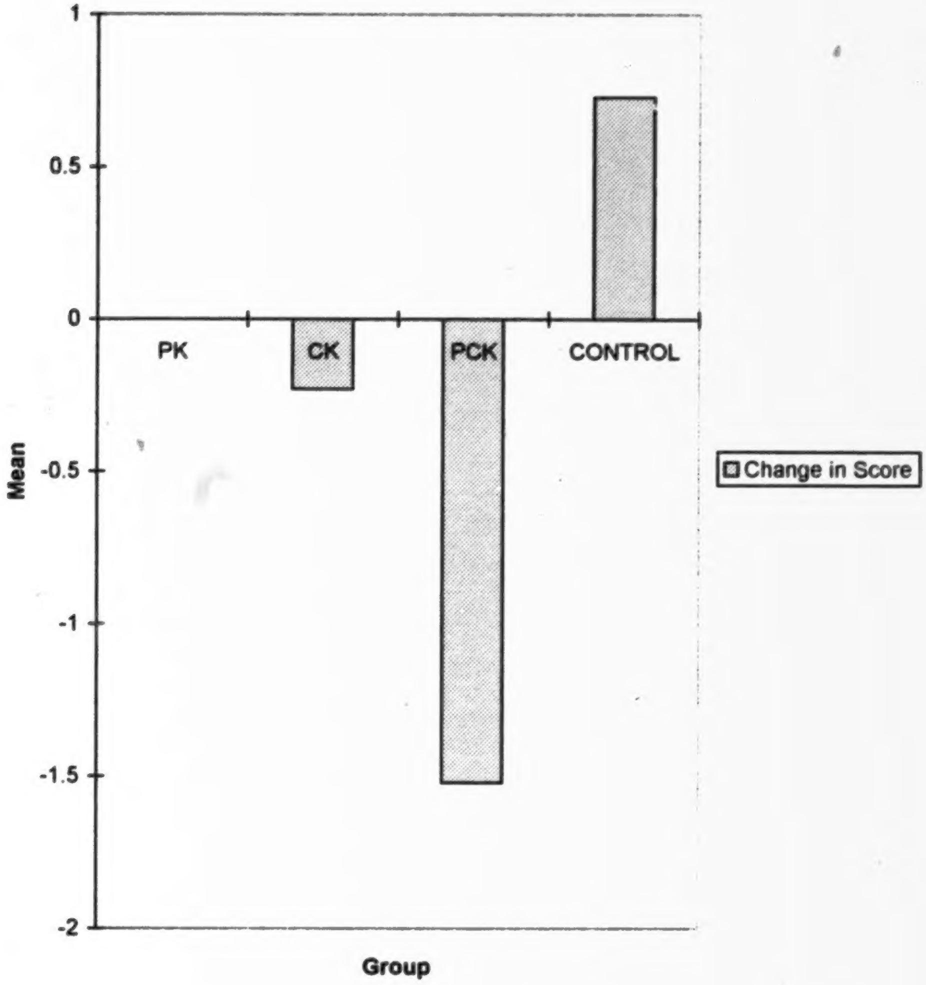

Figure 17. Mean change in the number of "general" feedback statements for the jump for each group.

When examining the data on the throw, a significant difference was noted between groups in the change in the number of "corrective, accurate, specific" statements (Table 13). The differences were between both the PCK and CK groups and the other two groups (Table 14, Fig. 18). This result was also found in the "other" category (Table 13). Once again the PCK and CK increased the mean number of statements in the "corrective, accurate, specific" category while decreasing the mean number of statements in the "other" category (Table 14, Fig. 19).

Table 13

Throw Feedback ANOVA Results: Group X Change in the Number of Statements

Statements	Degrees Of Freedom	F-Ratio	p-Value
Corrective, Accurate, Specific	3, 96	$6.3322^{\dagger a}$	0.0006
General	3, 96	1.1174	0.3460
Inaccurate	3, 96	1.1674	0.3263
Other	3, 96	$7.0878^{\dagger a}$	0.0002

Note:

[a] Newman-Keuls Test: significant difference between PCK and PK; PCK and Control; CK and PK; CK and Control.

$^{\dagger}p < .05$ one tailed, $^{*}p < .05$ two-tailed

Table 14

Summary Of Throw Feedback Statements For Each Group: Mean (Standard Deviation)

Statements	PK		CK		PCK		CONTROL	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Corrective Accurate Specific	2.12	2.56	1.73	3.31^{a}	1.22	3.35^{a}	1.62	1.96
	(1.24)	(1.39)	(1.73)	(1.62)	(0.85)	(1.70)	(1.27)	(1.42)
General	1.84	1.44	1.73	1.89	1.74	1.09	2.23	1.77
	(1.31)	(0.96)	(1.08)	(1.75)	(1.32)	(0.95)	(1.80)	(1.70)
Inaccurate	3.92	3.12	3.12	1.89	3.35	2.35	2.96	2.77
	(1.66)	(1.48)	(1.42)	(1.24)	(1.67)	(1.61)	(1.93)	(2.05)
Other	0.80	1.28	1.38	0.96^{a}	1.22	0.57^{a}	1.39	1.89
	(1.00)	(1.93)	(1.33)	(2.05)	(1.23)	(0.66)	(1.33)	(2.27)

Note:

[a] Newman-Keuls Test: significant difference between PCK and PK; PCK and Control; CK and PK; CK and Control.

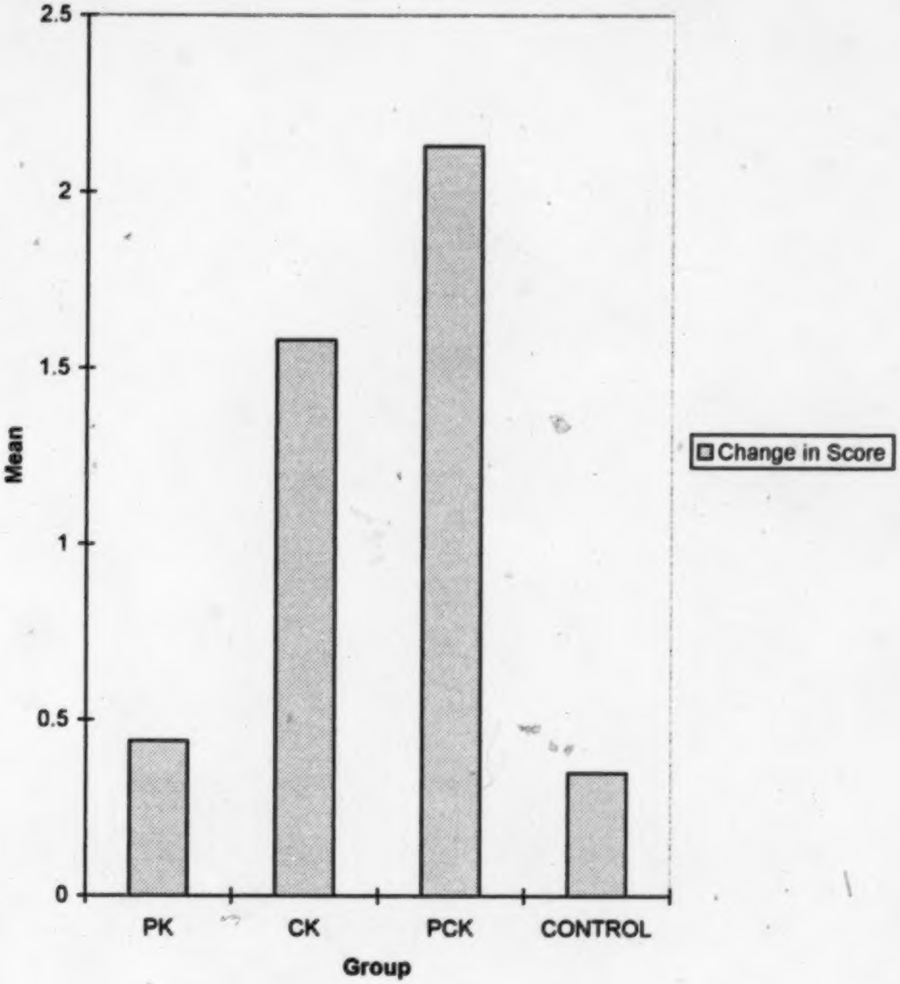

Figure 18. Mean change in the number of "corrective, accurate, specific" feedback statements for the throw for each group.

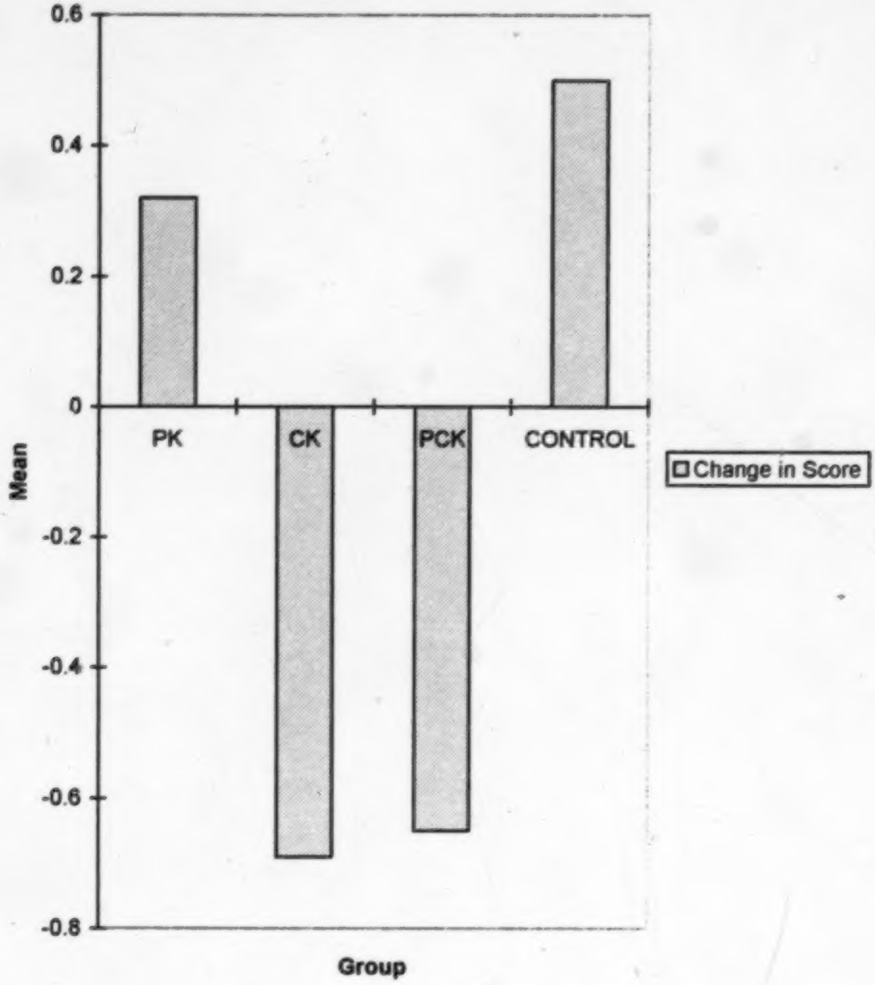

Figure 19. Mean change in the number of "other" feedback statements for the throw for each group.

The force production phase of the throw was the focus of the "corrective, accurate, specific" statements by all four groups in both the pre-test and post-test (Fig. 20; Appendix M, Table M4). This was consistent with the phase most frequently identified in the Observation test. The PCK and CK groups also focused attention on the preparation phase in the post-test with 23% and 25% (respectively) of the statements made identifying that phase (Fig. 21). Ten percent or fewer statements were recorded by any of the groups identifying the follow-through phase in both the pre-and post-test (Fig. 22), although the PCK group increased focus on this phase while the other three groups had little change in the proportion of responses focusing on the follow-through. This may or may not be valuable in problem solving for direction of performance improvement but it denotes a change in attention to all phases of the skill. The majority of statements relating to the force production phase were directed towards the stepping action as seen in the Observation test. Once again this was consistent with the findings of Walkwitz and Lee (1992a) and may be related to the simplicity of identifying the stepping action.

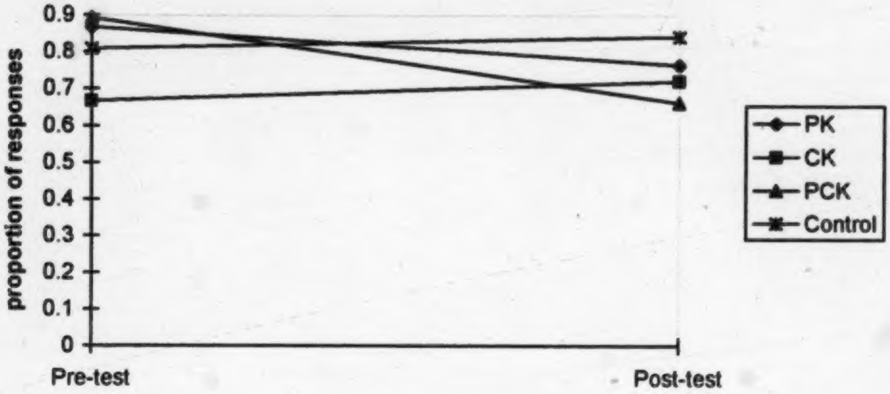

Figure 20. Proportion of "corrective, accurate, specific" responses in throw feedback tests identifying the force production phase.

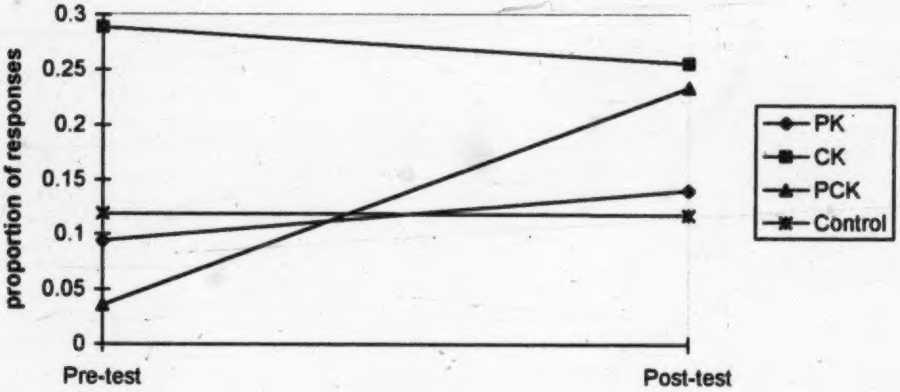

Figure 21. Proportion of "corrective, accurate, specific" responses in throw feedback tests identifying the preparation phase.

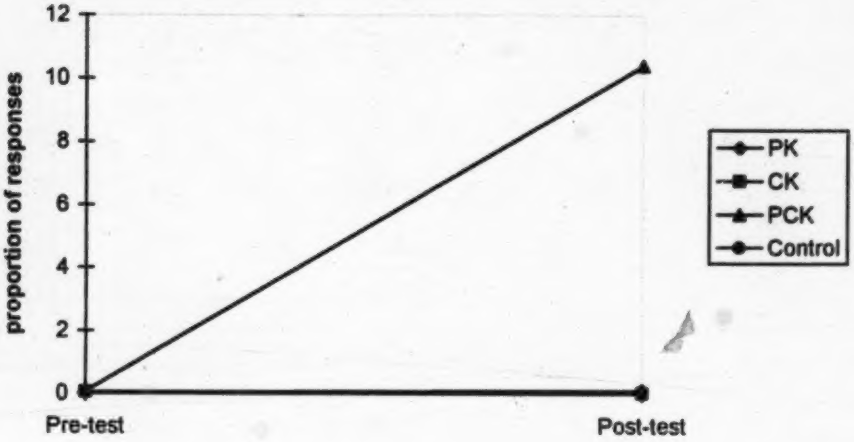

Figure 22. Proportion of "corrective, accurate, specific" responses in the throw feedback test identifying the follow through phase.

When examining the results of the feedback test, the PCK group significantly improved the feedback responses throughout the test. The CK group improved on their ability to provide feedback when evaluating the throw. The PCK group demonstrated the greatest improvement in the feedback test for the jump as a result of the treatment received. For the CK group, the treatment also provided improvement for feedback in the jump when compared to the PK and Control groups. These improvements resulted from an increased knowledge of the skill components which was part of the treatment for the CK group.

Summary of Test Results

In summary, when examining the Content portion of the evaluation procedures, both the PCK and CK groups showed significant differences from the other groups due to the treatment packages received. This was also true when examining the results of the analysis of the Observation test. It was not until the Feedback test was examined that any difference between the PCK and CK groups appeared. At this point, the PCK group showed the benefit of the combined pedagogical content knowledge treatment procedures, over the CK group, for one (the jump) of the two skills. Since the time allocated to the three treatments was virtually the same, this difference must be related to the approach to teaching the skill analysis. However, since the results observed on the feedback test were not consistent for both skills, it is difficult to determine what aspect of the treatment resulted in the difference between the CK and PCK groups on the Feedback test. The PCK group did have greater benefit in the formulation of the statements to provide a child with direction for improvement after the jumping skill was observed. This could indicate that the pedagogical content knowledge treatment ultimately enhanced the ability of the subject to generate corrective, relevant feedback on this physical skill for use when assisting a performer to improve. This differentiation between the PCK and CK groups was not evident for the throw, indicating that the treatment was not of sufficient length to enhance the evaluative processes for both skills to the point of creating a more enhanced feedback result. It may also be that the skill of the throw was "easier" to detect performance needs, as both the CK and PCK groups provided direction in the feedback statements to improve the stepping action.

Receiving the pedagogical knowledge (PK) only did not result in any differences between the pre-test and post-test, although a broader focus of the skill was observed in the Feedback test with the subjects identifying the three phases of the jump more consistently. There were also no significant differences observed when examining the results of the Control group, indicating that the testing procedures themselves did not enhance the ability of the subjects to improve on the post-tests. The fact that no differences appeared between the Control and PK groups may indicate that the Control group was gaining pedagogical knowledge from some other source within their education, or that the PK treatment was not strong enough to elicit a difference between these two groups.

Self-evaluation

The subjects rated their confidence in, awareness of, and competence in performing motor skill analysis for children prior to the pre-test and following the post-test procedures (Appendix K). The ANOVA results of the subjects' self-evaluation are presented in Table 15. There was no significant difference among groups in the change in ratings of confidence or competence for skill analysis from the pre-test period to the post-test period as a result of the treatments provided. This may be a result of an inflated perception of their abilities prior to the administration of the treatments, or a lack of strength in the treatments to alter the perceived confidence and competence of the subjects. The treatments may have required interaction with children for the subjects' confidence and competence to be impacted. There was a significant difference among groups noted in the awareness of what was involved in observing children in a physical activity setting. All three treatment groups were significantly different from the control group in the change in the awareness category, indicating they were more aware of the requirements of observing children in a physical activity setting (Table 16). This suggests that each treatment was perceived to have provided knowledge of the importance and complexity of the process of skill analysis. However, the subjects may have perceived that the programs received were not of sufficient length or application to make a difference in their confidence or competence in performing skill analysis on children. A more extreme treatment program, including work with actual children, may have been perceived to be required to have a greater impact on confidence and competence.

Table 15

Self-Evaluation ANOVA Results: Group X Change in Self Evaluation Ratings

	Degrees Of Freedom	F-Ratio	p-Value
Awareness	3, 96	4.5839 *[a]	0.0048
Confidence	3, 96	1.2001	0.3140
Competence	3, 96	2.0896	0.1067

Note:

[a] Newman-Keuls Test: significant difference between PCK and Control; CK and Control; PK and Control.

† $p < .05$ one-tailed, * $p < .05$ two-tailed

Table 16

Summary Of Subject Self-Evaluation: Mean (Standard Deviation)

Statements	PK		CK		PCK		CONTROL	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Awareness of Skill Analysis	5.88 (1.42)	6.84 *[a] (1.60)	5.88 (1.88)	6.96 *[a] (1.11)	5.52 (2.25)	7.21 *[a] (1.53)	4.69 (1.99)	4.46 (2.12)
Competence at Skill Analysis	5.80 (1.68)	6.24 (1.40)	6.15 (1.54)	6.08 (1.26)	5.39 (2.21)	6.17 (1.43)	5.03 (2.25)	4.61 (2.10)
Confidence in Skill Analysis	5.68 (1.79)	5.96 (1.24)	6.04 (1.75)	6.19 (1.38)	5.70 (2.38)	6.39 (1.23)	5.19 (2.12)	4.88 (2.20)

Note:

[a] Newman-Keuls Test: significant difference between PCK and Control; CK and Control; PK and Control.

[†] $p < .05$ one-tailed, * $p < .05$ two-tailed

CHAPTER 5

SUMMARY, CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS

Shulman (1987) stated that effective teachers possess a form of knowledge which represents a combination of many levels of knowledge, from subject-specific to curricular to student learning. He suggested further that effective teachers tend to integrate this knowledge into a complex form which he labeled pedagogical content knowledge. In recent years, many studies have examined teachers' knowledge and the concept of pedagogical content knowledge. The majority of these have compared the knowledge of experienced and novice teachers in an attempt to identify the difference in pedagogical content knowledge among the two groups. In all studies the experienced teachers had a superior level and use of pedagogical content knowledge. These studies also support the constructs of the knowledge component as defined by Shulman. Shulman has advocated the development of pedagogical content knowledge in teacher education but despite strong support for this approach, studies have not determined if teacher educators can teach pedagogical content knowledge to pre-service teachers, or if such knowledge can only be developed "on the job". The purpose of this study was to design and compare the effectiveness of three programs of teaching skill analysis of two fundamental motor skills to pre-service elementary school generalist teachers. The three programs were based on Shulman's concepts of pedagogical content knowledge, content knowledge, and pedagogical knowledge.

Hoffman (1977) identified the components of skill analysis using a pedagogical process which included content specificity. Barrett (1983) also identified components for observing children in a physical activity setting and, although the model did not include the practice of actually providing feedback to the child observed, it implied that good observation was a prerequisite. A combination of these two models provided a resource for the structuring of a pedagogical content knowledge approach for teaching skill analysis for future elementary school generalist teachers. The subject-specific content incorporated the motor development resources of Roberton and Halverson (1977, 1984), Gallahue (1982), and Haubenstricker and Seefeldt (1986), for the overarm throw and standing long jump. Developmental sequences are prominent in elementary physical education and motor development texts, although the focus of motor development is changing towards a dynamical systems approach. The sequential aspects of motor development when considering fundamental skills is still relevant to the direction of assessing development and was used for that purpose in this study.

Through a pre-test, post-test, quasi-experimental design, with control group, the three treatments (programs) were administered. The effectiveness of each treatment was determined by three pre-test and post-test evaluation procedures. A written test was administered first to evaluate the subjects' knowledge of motor development relating to two fundamental motor skills (overarm throw and standing long jump). Secondly, four video-taped performances of children jumping and throwing were observed and the subjects described each skill. Finally, a feedback test was administered in which the subjects provided simulated statements of feedback as direction for improvement on subsequent performances of the skills following observation of video-taped performances of four children on each of the skills.

Conclusions

A key aspect of teaching is often the provision of valuable, useful, relevant feedback to each student to help them progress to a higher level of functioning. This can not always be completed or achieved in a setting of group instruction by one teacher. The value of making each feedback opportunity as effective as possible, especially as such opportunities are limited in number, becomes obvious. The feedback provided should be specific to the individual and based on the accurate assessment of the individual's prior performances. The knowledge and ability to access each individual separately from the group and to create feedback appropriate to that individual is a valuable asset for a teacher. Within the limitations of this study, it has been demonstrated that when provided with content knowledge of developmental sequences of throwing and jumping, or pedagogical content knowledge of developmental sequences of throwing and jumping, observation and components of feedback, pre-service elementary education teachers can enhance their ability to provide corrective, accurate, specific feedback..

The results of this study indicate that both pedagogical content knowledge and content knowledge approaches were similarly effective in improving pre-service teachers' ability to learn skill analysis as it relates to the knowledge of the development of the skills and the ability to accurately describe the performance of children when observed on video-tape. However, when the subjects were asked to formulate feedback statements based on the performances observed, the pedagogical content knowledge group demonstrated superior ability in comparison to all groups in the post-test to provide effective statements of feedback based on the performances observed for the jumping skill. This provided support for the value of pedagogical content knowledge as a vehicle for providing simulated corrective, accurate, specific feedback to learners. The content knowledge group was also significantly different than the PK and control group on the feedback measure for the jump. Ultimately, the two treatment groups of PCK and CK were more equivalent in their knowledge demonstration in the post-test than would be expected in the theoretical framework as described by Shulman. The difference between these two treatment groups was only seen in one skill. This may be a result of the complexity of the skill observed. For example, the throw has an obvious action with the windup and step, where the jumping action may not be as easily delineated to the components and phases of the jump as they occur simultaneously. In retrospect, it is the opinion of the researcher that the content knowledge treatment group received more than pure content knowledge in the delivery of the treatment through the use of video-tape performances to "observe" during the teaching progression of development of fundamental motor skills. The method of delivering the observation and feedback pre-test and post-test, also could have restricted the demonstration of knowledge of the pedagogical content knowledge group by pre-choosing one angle for observing the skills. This component created a more standardized "playing field" for observation between the content and pedagogical content knowledge groups.

Despite these limitations, the study strongly supported the teaching of specific content of developmental sequences in physical education over the general movement principles taught to the pedagogical knowledge treatment group. Both the content and pedagogical content knowledge groups were more able to accurately observe the skill and formulate feedback statements. Since a primary educational goal of skill analysis is to provide feedback or indicate direction which will improve the performance of the learners observed, the pedagogical content knowledge approach to teaching skill analysis was deemed to be the more effective treatment in this study as it improved the ability of the subjects to evaluate and provide feedback on both skills (long jump and overarm throw). Furthermore, this treatment was delivered in a similar time frame to those focusing on only content or pedagogy.

Teaching the content of skill analysis in such a way that the future educator will consider the individual student within the teaching scenario was a major focus within the development of a pedagogical content knowledge approach to teacher education. The statements of feedback were the measure of pedagogical content knowledge through simulated interaction with elementary students. The provision of feedback designed for the individual learner was the focus of this study but is only one aspect of pedagogical content knowledge. Other aspects of pedagogical content knowledge not encompassed in this study include, for example, the individual learning styles and response to individual feedback by each student. The testing also did not bring into effect the individual considerations (such as the enthusiasm to learn or apply the learning) which would occur with pedagogical content knowledge. It is also not apparent in this study whether the PCK included or integrated within the teaching of this subject would be similar with other instructors.

Recommendations

This study was completed entirely in a classroom setting and not applied to the live observation of children in physical activity. For full evaluation of the effectiveness of using a pedagogical content knowledge approach to pre-service instruction, it is necessary to have the pre-service teachers observe children in a physical activity setting, followed by the application of the knowledge in a student teaching scenario. This and previous studies indicate that linking knowledge components is necessary when teaching teachers. This may not be necessary when teaching the content, but the research supports the inclusion of a link between different knowledge types within a teacher's education. For a novice teacher, mentors and/or workshops could focus on integrating the pedagogical content knowledge with examples appearing daily in the teaching environment. For continued research in this area, the interpretation of pedagogical, content and pedagogical content knowledge needs to be more clearly defined. The applications of these types of knowledge is not consistent in research. Also, measurement of pedagogical content knowledge would benefit from a multiple variable approach which includes evaluation of the interaction between teacher and student, and the degree of learning by the student.

Implications

With regard to teacher education, the results of this study support the contention that a pedagogical content knowledge approach to teaching would appear to be advantageous. Studies to date have described how experience relates to the pedagogical content knowledge base of teachers, and also how early development of pedagogical content knowledge can begin through student teaching experiences. This study provides further direction to incorporate the application and integration of pedagogy into content courses within early stages of teacher education. This may enhance the effectiveness of development of pedagogical content knowledge for teachers when they begin the experiential aspects of their education and entry into the teaching profession. Although pedagogical knowledge appears to be specific (Barrett & Collie, 1996), it may be that general concepts of augmented feedback could be integrated and reconfirmed at various phases of pre-service education to teach skills and also as a focus of teacher education. Feedback statements could be incorporated to evaluate the problem-solving aspect of teaching the individual learner. The use of feedback statements could also be further evaluated to direct alternative approaches to guide the learner to the desired outcome. Davis and Burton (1991) advocate altering the task to encourage or guide the child to a desired change in performance. Once the teacher has identified or evaluated the skill and determined what change may be desired to advance the skill performance, they may choose to alter the task or change the environment (size of ball for example) which will encourage a change in performance of the skill. The information processing and dynamic systems theories of motor development will provide further understanding of why delays in development occur and will afford other alternatives for solutions used in providing direction to the individual child within the teaching scenario. More research is required to determine how these theories can guide the direction of instruction (Roberton, 1993). In the mean time, through careful alteration or augmentation, content knowledge could be enriched to take on the form of pedagogical content knowledge. Pedagogical content knowledge should not be delayed and learned only through experience, as this study indicates the creation of potentially effective feedback can be acquired with the content knowledge but without the significant cost of time allocated for other critical aspects of instructor education.

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APPENDIX A

COURSE OUTLINE

THE UNIVERSITY OF ALBERTA
FACULTY OF PHYSICAL EDUCATION AND RECREATION
DEPARTMENT OF PHYSICAL EDUCATION AND SPORT STUDIES
PESS 292
INTRODUCTION TO THE MOVEMENT ACTIVITIES OF CHILDREN AGED 0-8
COURSE OUTLINE
FALL 1993

COURSE COORDINATOR:		**INSTRUCTOR:**	____________
OFFICE:	P-421	**OFFICE:**	________________
PHONE:	492-8274	**PHONE:**	_________________

ATTENDANCE:

Regular attendance and participation are expected at all sessions as much of the information provided cannot be obtained in any other way than through personal participation. Students with unexcused absences for more than 10% of classes may be refused permission to write the final examination. (See Section 152.8 of the University Calendar.)

DRESS:

Appropriate shorts and shirt and/or leotard and track suit. Most practical work in the gymnasium is done in bare feet but running shoes will also be needed. Also, there may be minimal use of skates and swim suits.

COURSE OBJECTIVES:

For the student to acquire:

1. a knowledge of the types of movement activities in which children 0-8 years of age engage.
2. an understanding of the characteristics and needs of children participating in movement activities.
3. knowledge and understanding of movement concepts with emphasis on their application to a variety of movement activities.
4. observation skills for assessment and understanding of how children develop movement skills.
5. knowledge of suitable environments for children to learn movement activities.

COURSE CONTENT:

Theory, discussion, observation and practical work will run concurrently throughout the course.

The content listed below will be integrated for presentation rather than considered separately.

1. A study of the movement activities engaged in by children 0-8 years of age.
   - the types of functional and expressive activities.
   - the content of activities.
   - the suitability of activities for children within this age group.
   - the organization and progressive development of activities.
2. An introduction to the characteristics and needs of children 0-8 years of age.
   - growth and development: cognitive, affective and psychomotor.
   - age characteristics.
   - the needs of children for physical activity.
   - skill acquisition.
3. Movement analysis.
   - basic kinesiological principles and Laban's principles of movement.
   - the application of these principles for observation, activity analysis and task setting.
4. Observation of children in activity settings.
   - observation techniques.
   - identify levels of skill proficiency.
   - analyze the child's use of movement concepts.
5. The provision of suitable environments and activities for children 0-8 years of age.
   - suitable equipment and environments for the promotion of activity.
   - ways of helping children learn more about themselves and the values of physical activity in their lives.
   - free play and structured activity settings, their value and limitations.

REQUIRED TEXT: Wall, J., & Murray, N. (1990). Children and movement. Dubuque, IA: Wm. C. Brown Publishers.

RECOMMENDED TEST: Graham, G., Holt/Hale, S. & Parker, M. (1993). Children moving (3rd Edition). Palo Alto, CA: Mayfield Publishing Co.

Kruger, H. & Kruger, J. (1989) The preschool teacher's guide to movement. Baltimore, MD: Gerstung Publications.

NOTE: There is a large number of books and readings on reserve in the Education Library for use in this course as supplementary reading material.

EVALUATION :

Term Work: 65% Assignments - 35%
Practical Application - 10%
Mid Term Examination - 20% (Refer to "Term Examinations", U of A Calendar, Section 23.5.2)

Final examination: 35% (Set during Test Week. See University Examination Schedules in Registration Procedures Booklet. Normally there shall be no departure from the official Final Examinations Schedule, U of A Calendar, Section 23.5.3(2). Also note U of A Calendar, Section 23.5.7 for regulations regarding "Deferred Final Examinations").

THE MAJOR ASSIGNMENT WILL FOCUS ON THE OBSERVATION OF CHILDREN INVOLVED IN MOVEMENT ACTIVITIES. EACH INSTRUCTOR WILL PROVIDE WRITTEN DETAILS OF THE ASSIGNMENTS AND THEIR DUE DATES.

PLAGIARISM

The requirements of most, if not all, university courses include the completion and submission of original reports, term papers or some other form of student work. Usually the use of existing sources of information is appropriate and encouraged, or even required. However, it is crucial that proper credit be given to the authors of these sources at the point at which they are used. Failure to do so implies that the information is the work of the submitting student and may constitute plagiarism.

Plagiarism: No student shall submit the words, ideas, images or data of another person as the student's own in any academic writing, essay, thesis, research project or assignment in a course or program of study. (Section 26.4, U of A Calendar).

It is the student's responsibility to avoid plagiarism while meeting the research requirements of assignments. It is therefore important to know an appropriate format for citing and crediting sources. If the student is still unsure what constitutes plagiarism, consultation with the instructor/supervisor should occur.

THE UNIVERSITY OF ALBERTA
FACULTY OF PHYSICAL EDUCATION AND RECREATION
DEPARTMENT OF PHYSICAL EDUCATION AND SPORT STUDIES
PESS 293
INTRODUCTION TO THE MOVEMENT ACTIVITIES OF CHILDREN AGED 5-12
COURSE OUTLINE
FALL 1993

COURSE COORDINATOR:		**INSTRUCTOR:** ____________
OFFICE:	P-421	**OFFICE:** ______________
PHONE:	492-8274	**PHONE:** ________________

ATTENDANCE:
Regular attendance and participation are expected at all sessions as much of the information provided cannot be obtained in any other way than through personal participation. Students with unexcused absences for more than 10% of classes may be refused permission to write the final examination. (See Section 152.8 of the University Calendar.)

DRESS:
Appropriate shorts and shirt and/or leotard and track suit. Most practical work in the gymnasium is done in bare feet but running shoes will also be needed. Also, there may be minimal use of skates and swim suits.

COURSE OBJECTIVES:
For the student to acquire:

1. a knowledge of the types of movement activities in which children 5-12 years of age engage.
2. an understanding of the characteristics and needs of children participating in movement activities.
3. knowledge and understanding of movement concepts with emphasis on their application to a variety of movement activities.
4. observation skills for assessment and understanding of how children develop movement skills.
5. knowledge of suitable environments for children to learn movement activities.

COURSE CONTENT:
Theory, discussion, observation and practical work will run concurrently throughout the course. The content listed below will be integrated for presentation rather than considered separately.

1. A study of the movement activities engaged in by children 5-12 years of age.
   a. the types of functional and expressive activities.
   b. the content of activities.
   c. the suitability of activities for children within this age group.
   d. the organization and progressive development of activities.
2. An introduction to the characteristics and needs of children 5-12 years of age.
   a. growth and development; cognitive, affective and psychomotor.
   b. age characteristics.
   c. the needs of children for physical activity.
   d. skill acquisition.
3. Movement analysis.
   a. basic kinesiological principles and Laban's principles of movement.
   b. the application of these principles for observation, activity analysis and task setting.
4. Observation of children in activity settings.
   a. observation techniques.
   b. identify levels of skill proficiency.
   c. analyze the child's use of movement concepts.
5. The provision of suitable environments and activities for children 5-12 years of age.
   a. suitable equipment and environments for the promotion of activity.
   b. ways of helping children learn more about themselves and the values of physical activity in their lives.
   c. free play and structured activity settings, their values and limitations.

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RECOMMENDED TEST: Graham, G., Holt/Hale, S. & Parker, M. (1993). Children moving (3rd Edition). Palo Alto, CA: Mayfield Publishing Co.
Kruger, H. & Kruger, J. (1989) The preschool teacher's guide to movement.

Baltimore, MD: Gerstung Publications.

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Practical Application - 10%
Mid Term Examination - 20% (Refer to "Term Examinations", U of A Calendar, Section 23.5.2)

Final examination: 35% (Set during Test Week. See University Examination Schedules in Registration Procedures Booklet. Normally there shall be no departure from the official Final Examinations Schedule, U of A Calendar, Section 23.5.3(2). Also note U of A Calendar, Section 23.5.7 for regulations regarding "Deferred Final Examinations").

THE MAJOR ASSIGNMENT WILL FOCUS ON THE OBSERVATION OF CHILDREN INVOLVED IN MOVEMENT ACTIVITIES. EACH INSTRUCTOR WILL PROVIDE WRITTEN DETAILS OF THE ASSIGNMENTS AND THEIR DUE DATES.

PLAGIARISM

The requirements of most, if not all, university courses include the completion and submission of original reports, term papers or some other form of student work. Usually the use of existing sources of information is appropriate and encouraged, or even required. However, it is crucial that proper credit be given to the authors of these sources at the point at which they are used. Failure to do so implies that the information is the work of the submitting student and may constitute plagiarism.

Plagiarism: No student shall submit the words, ideas, images or data of another person as the student's own in any academic writing, essay, thesis, research project or assignment in a course or program of study. (Section 26.4, U of A Calendar).

It is the student's responsibility to avoid plagiarism while meeting the research requirements of assignments. It is therefore important to know an appropriate format for citing and crediting sources. If the student is still unsure what constitutes plagiarism, consultation with the instructor/supervisor should occur.

APPENDIX B

INFORMED CONSENT FORM

Project: Developmental Motor Patterns Analysis

Investigator: Nora R. Way 492-1042

I, ____________________________(please print), agree to participate in a research project conducted by Nora R. Way and supervised by Dr. A.B. Nielsen for the purpose of studying the acquisition of knowledge and instructor preparation in selected fundamental motor skills. I understand that I may decline to enter or may withdraw from the study at any time without any consequences to myself or to my academic progress.

I recognize that I may be asked to participate in the following procedures during this study:

> To view a video-tape of several performances of fundamental motor skills and provide, in writing, feedback concerning these performances. This information will be used as data for analysis in conjunction with a written measure of knowledge of selected developmental sequences.
>
> I will be asked to supply my student identification number on all information I provide for the study. However, I understand that my identity will be held in confidence and the data will not be processed until all the data is collected and the student number has been replaced by a coded subject number with which my identity cannot be determined.

The total amount of time required for data collection during this project not exceed one hour and will occur as part of the regular class schedule. I understand that my attendance is critical to this study.

The intention of this project is to enhance the delivery of knowledge that teachers require to aid their students in acquisition of fundamental motor skills.

Subject

Name: ______________________ ID #: ____________

Signature: ______________________ Date: ____________

Investigator

Nora R. Way Telephone: Office 492-1042

Department of Physical Education and Sport Studies University of Alberta

Signature: ______________ Witness: ______________

Date: ______________

(Dr. A.B. Nielsen, 492-3839)

APPENDIX C

INFORMED CONSENT FOR VIDEO-TAPE SUBJECTS

Dear Parent or Guardian,
A research project will be conducted from September 1993 to March 1994, at the University of Alberta. The purpose of the research is to develop an effective instructional program to teach future elementary school teachers how to observe and provide corrective feedback to students performing two fundamental motor skills (overarm throw and standing long jump).

Part of this project will include the observation by the teachers of a video-tape of skills performed by children. I would like to video-tape a variety of children performing the two skills. The children will be video-taped performing the skills from a variety of camera angles. The time for videotaping each child will be approximately 15 minutes. The video-tape will then be edited to remove all sound and to include only the performance of the skill. Not all performances by all children will be used in the final edition of the video-tape. The video-tape will be used for this study only.

If you volunteer your child to participate in the development of the video-tape, please complete the following informed consent form. As a volunteer in this study the child may withdraw at any time by indicating to the researcher that they do not wish to participate. You will receive written confirmation that the consent form was received and you will be given a copy of the form you completed.

Thank you in advance for considering allowing your child to participate in this study. Every child who participates plays a key role in allowing me to provide the teachers with a constructive instructional unit to assist them in developing their teaching skills. I await your response.
Yours truly,

Nora R. Way
Department of Physical Education and Sport Studies
University of Alberta
Edmonton, Alberta, T6G 2H9
Phone: (403) 492-5503 (403) 489-8590
(Or Dr. A.B. Nielsen, same address, Phone 492-3839)

Motor Skills Video-tape Consent Form

My signature on this form indicates that my child will participate in a study conducted by Nora Way on "The Effects of Pedagogical Content Knowledge on the Ability to Observe and Provide Feedback on Fundamental Motor Skill Performance" and indicates that I understand the following:

I consent to have my child, ______________________________ (name), participate in the study.

I understand that he/she has the right to withdraw from the study at any time without prejudice.

I have received an explanation about the nature of the study, its purpose and my child's involvement in the study (through letter and opportunity to discuss with the researcher).

There should be no danger of physical or psychological harm.

The data collected will be confidential, as will my child's identity.

______________________________ ______________________________

Signature of Parent/Guardian

Name of Parent/Guardian
Print Last Name, First Name

______________________________ ______________________________

Name of Child
Print Last Name, First Name

Date of Signature

Please return this completed form to the researcher. Keep the covering letter for your own information. You will receive a copy of the completed form and acknowledgment of receipt of the form.

Thank you.

APPENDIX D

SUBJECT QUESTIONNAIRE

Subject Number: ______________________ Age: _______________

Gender: FEMALE ____ MALE ____

Degree program in which you are presently enrolled: ________________________

Do you already have a post secondary degree? YES ____ NO ____
If yes, what degree(s)? ________________________________

Have you any previous teaching or instructional experience with children? (Circle one.)

LESS THAN 1 YR.	1 TO 2 YRS.	3 TO 5 YRS.	MORE THAN 5 YRS.

Describe your experience (age group, subject, activities, etc).

Have you previous experience as a competitor in a physical activity?
YES ____ NO ____
If yes, indicate what activity, level, age, and the number of years involved.
____
____
____
____

Have you previous experience as a coach in a physical activity?
YES ____ NO ____
If yes, indicate what activity, level, age group, and the number of years involved.
____

____

Have you previous experience as an official in a physical activity?
YES _____ NO _____

If yes, indicate what activity, level, age group, and the number of years involved.

____

____

Are you a parent? YES _____ NO _____
If yes, how many children and what are their ages?

____

Are your children involved in organized extracurricular physical activities?
YES ____ NO___
If yes, what activities?

____

Do you observe their participation? YES _______ NO _________

Circle a number which corresponds to your feeling for each of the following.

To what extent do you feel **confident** of your ability as an analytic observer of children in a physical activity setting?

0	1	2	3	4	5	6	7	8	9	10
None			Somewhat				Quite			Extremely

To what extent do you feel you are **aware** of what effective observation of children involves in a physical activity setting?

0	1	2	3	4	5	6	7	8	9	10
None			Somewhat				Quite			Extremely

To what extent do you feel **competent** of your ability as an analytic observer of children in a physical activity setting?

0	1	2	3	4	5	6	7	8	9	10
None			Somewhat				Quite			Extremely

APPENDIX E

SUBJECT KNOWLEDGE TEST

Subject Number: ____________________

INSTRUCTIONS

Each page contains one question with two parts. Answer each part by **circling** a response at the right of the question.

Please respond to **all** questions (i.e., do not leave any blanks).

A category is available if you are uncertain of the correct response.

Answer each question in order, and **DO NOT** return to a question once you have turned the page.

1. PART A
Is the following motion part of a mature jumping pattern?

During the flight phase of the standing long jump, the child tucks the knees and hips up at the same time.	**YES**	**NO**	**NOT SURE**

PART B
If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

During the flight phase of the jump, the legs are not carried symmetrically.	**YES**	**NO**	**NOT SURE**
During the flight phase of the jump, the knees flex, then the hips flex, to bring the legs into a tuck.	**YES**	**NO**	**NOT SURE**
During the flight phase of the jump, the legs are kept almost straight as they are brought forward.	**YES**	**NO**	**NOT SURE**

2. PART A

Is the following motion part of a mature jumping pattern?

During the flight phase of the standing long jump, the child's arms are held out or away from the sides of the body.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

During the flight phase of the jump, the child's arms move away from the sides and backwards.	**YES**	**NO**	**NOT SURE**
During the flight phase of the jump, the child's arms are extended over the head.	**YES**	**NO**	**NOT SURE**
During the flight phase of the jump, the child's arms are held close to the sides of the body.	**YES**	**NO**	**NOT SURE**

3. PART A

Is the following motion part of a mature jumping pattern?

During the take-off of the standing long jump, the child's body leans forward from the vertical position, at an angle greater than 30 degrees.	YES	NO	NOT SURE

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

During the take-off of the jump, the child's body arches backwards (hyperextends).	YES	NO	NOT SURE
During the take-off of the jump, the child's body remains in an almost vertical position.	YES	NO	NOT SURE
During the take-off of the jump, the child's body leans slightly forward.	YES	NO	NOT SURE

4. PART A

Is the following motion a part of a mature jumping pattern?

During the takeoff of the standing long jump, the joints of the legs partially extend and the feet leave the ground simultaneously.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

The joints of the legs extend fully, and the feet leave the ground simultaneously.	**YES**	**NO**	**NOT SURE**
The legs do not fully extend the legs and the feet do not leave the ground simultaneously.	**YES**	**NO**	**NOT SURE**
The child leans forward to a point where it is necessary for her/him to move the feet forward to catch her/his balance.	**YES**	**NO**	**NOT SURE**

5. PART A
Is the following motion part of a mature jumping pattern?

As a child lands from a standing long jump, the child's arms swing naturally forward.	**YES**	**NO**	**NOT SURE**

PART B
If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

The arms are lowered from over head and reach forward on the landing.	**YES**	**NO**	**NOT SURE**
The arms are lowered from overhead on the landing, to a position out to the side to maintain balance.	**YES**	**NO**	**NOT SURE**
The arms move forward from a low position behind the body during the landing.	**YES**	**NO**	**NOT SURE**

6. PART A

Is the following motion part of a mature throwing pattern?

During the forward action of a forceful overarm throw, a right-handed child steps forward with the right foot.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

The child's weight is balanced evenly on both feet.	**YES**	**NO**	**NOT SURE**
The right-handed child steps forward with the left foot.	**YES**	**NO**	**NOT SURE**
The right-handed child stands with feet side by side, but does not step.	**YES**	**NO**	**NOT SURE**

7. PART A

Is the following motion part of a mature throwing pattern?

During the forward action of a forceful overarm throw, a child's upper arm moves forward in a horizontal path before the elbow extends.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

The upper arm remains stationary in front of the body while the elbow extends.	**YES**	**NO**	**NOT SURE**
The upper arm is held in a stationary, horizontal position out to the side of the body while the elbow extends.	**YES**	**NO**	**NOT SURE**
The upper arm is held in a stationary horizontal position in front of the body while the elbow extends.	**YES**	**NO**	**NOT SURE**

8. PART A

Is the following motion part of a mature throwing pattern?

As a right-handed child prepares to perform a forceful overarm throw, the trunk rotates slightly to the right.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

As a right-handed child prepares to perform a forceful overarm throw, the trunk arches backwards.	**YES**	**NO**	**NOT SURE**
As a right-handed child prepares to perform a forceful overarm throw, the trunk remains upright and facing forward.	**YES**	**NO**	**NOT SURE**
As a right-handed child prepares to perform a forceful overarm throw, the trunk rotates substantially to the right.	**YES**	**NO**	**NOT SURE**

9. PART A

Is the following motion part of a mature throwing pattern?

As a child executes a forceful overarm throw, the forearm and ball move steadily forward together to the point of release.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

The forearm appears to delay or lag behind the rotation of the child's body, but the elbow begins to extend half way through the rotation.	**YES**	**NO**	**NOT SURE**
The forearm appears to move forward as a part of the body rotation, but the elbow begins to extend before the body has completed rotation.	**YES**	**NO**	**NOT SURE**
The forearm lags behind the body rotation until the child is facing forward, at which point the elbow begins to extend.	**YES**	**NO**	**NOT SURE**

10. PART A

Is the following motion part of a mature throwing pattern?

In preparing for a forceful overarm throw, a child brings the ball to a position behind the head by a circular overhead movement with the elbow straight.	**YES**	**NO**	**NOT SURE**

PART B

If a child does NOT yet demonstrate the characteristic described above, which characteristic listed below might you observe? (There may be more than one.)

The child brings the ball upwards and/or to the side, then backwards to a position behind the head.	**YES**	**NO**	**NOT SURE**
The child brings the ball to a position behind the head by a circular movement downwards and backwards.	**YES**	**NO**	**NOT SURE**
The child brings the ball upward to a position beside or in front of the face	**YES**	**NO**	**NOT SURE**

APPENDIX F

KNOWLEDGE TEST PILOT STUDIES

The written content knowledge test was designed to determine the ability of the subjects to recognize components of mature movement patterns or sequences and those which are considered to be developmental lead-up patterns (McClenaghan & Gallahue, 1978; Roberton & Halverson, 1984) for the throw and jump. The test consisted of series of questions on the throw and jump, with each question including two parts. The first part gave a description of a component of the throw or jump pattern. The subject was instructed to identify whether the component as described was typical of a mature pattern for that skill. The second part incorporated three further descriptions of the same component which would precede or follow the original in the developmental process. The subjects were asked to identify which, if any, of the three might they observe if the child had not yet developed the ability to perform "part one". In this way, they were to identify any descriptions representing patterns preceding the originally described performance. One, two, three, or none of the statements could have preceded the original statement in the development of the throwing or jumping pattern. For each statement, the subjects could select from three responses (yes, no, not sure).

Pilot Study 1

The original test of three questions for the throw and jump was administered to third year Physical Education Undergraduates. The purpose of the study was to identify problems in question design and to determine if the test was sensitive to changes in knowledge due to instruction. The students (N=70) were requested to respond to the questions, and to identify confusing statements within the test items or the directions. Five days later, the students repeated the test on the throw only. During the period between the tests, the subjects received instruction dealing with developmental aspects of throwing, whereas they had received instruction regarding development of jumping prior to the pre-test. Some of the students (N=35) repeated the original test, while others (N=39) were given a version reflecting revisions resulting from the pre-test. The tests were randomly distributed to the students.

Results

The results of the test were used to examine the proportion of correct responses. Nine correct answers for both the throw and jump in both versions of the written test were possible. Using five correct responses (55%) as a standard by which to evaluate the trend of scores, it was determined that 56% and 36% of the respondents obtained a score of 5 or more on the jump and throw sections, respectively, on the first exposure to the test. The second administration of the test, using only the questions on the throw, showed marked improvement in number of subjects having five correct responses or more: 63% of the students answering the original version of the questions had five correct responses or more, while 90% of the subjects responding to the revised questions scored five or greater. The revised edition showed a greater improvement (from 36% to 93%) in performance than the original (from 36% to 63%). This was due to improved clarity of the questions. However, for both groups there was a marked improvement on the test scores from the first to the second test, indicating an increased understanding of developmental sequences following instruction on throwing patterns. The test identified improvement in content knowledge following instruction in the subject area and, with some minor changes, was deemed appropriate for use in the final study.

Pilot Study 2

The second edition of the test was modified and two questions were added to each section (throw and jump), to give a more extensive coverage of the knowledge requirement. The second pilot test was conducted using 31 (19 female, 2 male) University of Alberta undergraduate elementary education students registered in a required physical education course (PESS 293, Appendix A). The purpose of this study was to determine whether completion of the test itself would alter the content knowledge of the subjects. The subjects were administered the test twice, 12 days apart, at the beginning of their regular class period. The 12-day period between tests included four class periods which would be used to impart the treatment of the study. However, for this pilot study, no instruction on skill analysis or developmental sequences of the throw or jump motor patterns was given between testing periods. There was no time limit in responding to the test items. The data was analyzed using a 2 X 10 (times by questions) ANOVA, to determine if there were significant differences between the first and second test responses. The scores for each subject were coded using a three point code system for each subquestion, which was then averaged for each question. The results showed no significant differences on any question ($p \leq$

0.05) (Table E1). The results indicate that simply taking the test does not increase the knowledge of the subjects in the area of developmental motor patterns on components of the throw and jump.

Table E1

Test Question ANOVA Results

COMPONENT VARIABLE	F RATIO	p VALUE
JUMP - LEGS FLIGHT	3.20	0.08
JUMP - ARM FLIGHT	1.09	0.30
JUMP - TRUNK TAKE-OFF	1.03	0.32
JUMP - LEG TAKE-OFF	0.72	0.40
JUMP - ARM LANDING	0.79	0.38
THROW - LEG STEP	0.04	0.84
THROW - UPPER ARM	0.39	0.54
THROW - TRUNK ROTATION	2.32	0.14
THROW - FOREARM LAG	2.71	0.11
THROW - ARM PREPARATION	0.54	0.47

APPENDIX G

FEEDBACK TEST SHEET

SUBJECT NUMBER ____________

Please respond to all questions in pen.

The ultimate goal of teaching is to improve the child's performance and learning.

For each skill observed, provide up to three statements of feedback which you would say to the child in order to improve their performance.

Skill JUMP 1 2 3 4

1. ____

2. ____

3. ____

PLEASE PLACE AN "X" IN THE BLANKS NOT USED.

The ultimate goal of teaching is to improve the child's performance and learning.

For each skill observed, provide up to three statements of feedback which you would say to the child in order to improve their performance.

Skill THROW 1 2 3 4

1. ____

2. ____

3. ____

PLEASE PLACE AN "X" IN THE BLANKS NOT USED.

APPENDIX H

FEEDBACK SCORESHEET

SKILL: JUMP THROW 1 2 3 4 PRE-TEST POST-TEST

SUB #	CORRECTIVE ACCURATE SPECIFIC			CORRECTIVE ACCURATE GENERAL	CORRECTIVE INACCURATE	OTHER
JUMP	P/TO	FLT	LND			
THROW	P	FP	FT			

JUMP **P/TO**: PREPARATION. **FLT**: FLIGHT **LND**: LANDING

THROW: **P**: PREPARATION **FP**: FORCE PRODUCTION
FT: FOLLOW-THROUGH

APPENDIX I

OBSERVATION TEST SHEET

SUBJECT NUMBER ____________________

Describe the skill as performed.

JUMP 1 2 3 4

Describe the skill as performed.

THROW 1 2 3 4

APPENDIX J

OBSERVATION SCORESHEET

SKILL: JUMP THROW 1 2 3 4 PRE-TEST POST-TEST

SUB #	ACCURATE SPECIFIC			ACCURATE GENERAL	INACCURATE	OTHER
	P/TO	FLT	LND			
	P	FP	FT			

JUMP **P/TO**: PREPARATION. **FLT**: FLIGHT **LND**: LANDING

THROW: **P**: PREPARATION **FP**: FORCE PRODUCTION

FT: FOLLOW-THROUGH

APPENDIX K

POST-TEST QUESTIONNAIRE

Subject Number: ______________________

To what extent do you feel confident of your ability as an analytic observer of children in a physical activity setting?

0 1 2 3 4 5 6 7 8 9 10
None Somewhat Quite Extremely

To what extent do you feel you are aware of what effective observation of children involves in a physical activity setting?

0 1 2 3 4 5 6 7 8 9 10
None Somewhat Quite Extremely

To what extent do you feel competent of your ability as an analytic observer of children in a physical activity setting?

0 1 2 3 4 5 6 7 8 9 10
None Somewhat Quite Extremely

Briefly describe and evaluate the main points that you learned in the sessions provided by Nora Way.

APPENDIX L

VIDEO ASSESSMENT

M = Mature I = Immature

SKILL: Jump 1

	PREPARATION TAKEOFF	FLIGHT	LANDING
ARMS	* arms well back but not quite symmetric (I). TAKEOFF * extended above head (M), not quite symmetric (I).	* arms lower and abduct (out to the side) (I). * medially rotate (I).	* arms move from the side to behind the body (behind legs) (I). * no reach (I).
TRUNK/ BODY	* body lean is greater than 30 (M). * head back (I). TAKEOFF * body lean greater than 30 (M). * head slightly back (I).	* maintains body lean then increases lean in preparation for landing (M). * head aligned (M).	* head back (I). * trunk flexes fully at the waist (I).
LEGS	* knees bent well - 90 (M). TAKEOFF * legs extended (M). * 2 foot takeoff (M). * legs at 45 (M).	* limited tuck (I). * feet only come off the ground 6-10 inches (I). * symmetric (M). * legs are not extended in preparation for landing (I).	* 2 foot landing (M). * heels contact the ground first (M). * knees bend - slightly less than 45 (I). * steps forward after landing to gain balance (I).

SKILL: JUMP 2

	PREPARATION TAKEOFF	FLIGHT	LANDING
ARMS	* backswing full to a position head level (M), but not quite symmetric (I). TAKEOFF * left arm extends almost fully above the head (I). * right arm flexes and is held close to the body (I).	* left arm extends forward, and medially rotates (I). * right arm remains flexed and close to the body (I).	* left arm reaches toward the ground (M), but not symmetric with right (I). * right arm extends back behind the legs (I).
TRUNK/ BODY	* trunk leans to a position parallel with the ground (I). * head is back (I). TAKEOFF * body lean is 45 (M). * head is aligned (M).	* body lean increases in preparation for landing (I). * tucks chin (I).	* trunk flexes over knees, to a position parallel to the ground (I).
LEGS	* feet are staggered (left forward) (I). * knees not quite bent to 45 (I). * steps with left foot (I). TAKEOFF * legs extend fully (M). * 2 foot takeoff (M) (with left foot forward) (I).	* legs tuck slightly (but not enough) (I). * symmetric (M).	* heels land first but close to a flat footed landing (I). * 2 foot landing (M). * knees flex to 45 (I).

Fairly powerful jump. Asymmetrical - especially poor right arm use and right leg is behind left leg.

Good reach with legs on landing but poor - - incomplete flexion of knees and hips in flight.

SKILL: JUMP 3

	PREPARATION TAKEOFF	FLIGHT	LANDING
ARMS	* backswing extension to shoulder height (left arm lags) (I). * arms come forward together (M). TAKEOFF * arms partially extend to eye level (stop before fully extended) (I). * close to symmetric (I-M).	* arms move back to the side of the body (ant/post plane) (I). * close to symmetric (I-M). * no abduction/adduction or rotation movements in any phase (I).	* extend behind the body (I). * close to symmetric (I-M). * no reach on landing (I).
TRUNK/ BODY	* body lean greater than 30 (M). TAKEOFF * body lean 30 - 35 (M). * head aligned (M).	* lean decreases slightly to more upright (I). * head aligned (M).	* body maintains the same lean, i.e., almost upright (I).
LEGS	* knees bend to 90 (M). TAKEOFF * legs extend (M). * 2 foot takeoff (M). * feet together not spread (I). * symmetric (M).	* little knee flexion - almost straight (I). * symmetric (M).	* heels land first (M). * 2 foot landing (M). * legs partially flex (I).

- ground helps absorb the force.
- many inaccurate feedback statements (subject instructed the child to do something she was already doing).

SKILL: JUMP 4

	PREPARATION TAKEOFF	FLIGHT	LANDING
ARMS	* straight and extended behind body to shoulder height (M). TAKEOFF * partially extended to overhead (I). * bent at the elbow (I). * symmetrical (M).	* arms move from overhead to forward (M). * symmetric (M).	* arms reach forward (M) but are still partially flexed (I). * symmetric (M).
TRUNK / BODY	* body lean is less than 30 (I). * head is back (I). TAKEOFF * head back (I). * lean greater than 30 (M).	* lean less than 30 (I). * head back (I).	* lean reduces (I). * trunk is almost upright (I).
LEGS	* knees bend not quite to 90 (I). TAKEOFF * 2 foot takeoff (M), feet shoulder width apart (M). * 45 at takeoff (I). * partial extension of knees (almost full) (I). * symmetrical (M). * out toeing (I). * legs at hip do not totally align with the body (i.e., hips are slightly flexed) (I).	* tucks feet up - hips and knees flex together - incomplete (I). * begins to extend legs for landing (M). * symmetrical (M).	* 2 foot landing (M). * knees flex to 45 (I). * flat footed (I). * feet shoulder width apart (M).

SKILL: THROW 1

	PREPARATION	THROW	FOLLOW-THROUGH
ARM RIGHT	* arm swings downward and backward (circular) to a position behind the right side of the head (M). * elbow flexes (M).	* upper arm moves horizontally forward (M). * elbow leads or precedes the humerus movement (humerus action is independent) (I). * forearm lag (M). * arm does not completely extend (I). * flexes the wrist at release (M).	* arm cross body above the waist (M). * elbow is flexed (I).
TRUNK BODY	* body rotates to the right (block) (I). * head facing toward target (M).	* block rotation of body to a front facing position (I).	* upright (straight), forward facing (I).
LEGS	* small step with right foot (I). * foot placed laterally (I).	* long contralateral step (left foot) - at least half a body length (M). * weight transfers to front (left) foot completely (M). * left leg does not flex to accommodate the throw - stays extended (I).	* right foot comes forward to a position even with the left foot (M).

SKILL: THROW 2

	PREPARATION	THROW	FOLLOW-THROUGH
ARM RIGHT	* elbow flexes and the shoulder horizontally extends to take the ball to a position slightly behind and to the right of the head (I).	* humerus moves forward with upper body rotation (I). * elbow lag is present (M). * releases ball before arm reaches full extension - just above and to the right of the head (I).	* arms extends and crosses body at waist level - diagonally down (M). * arm almost fully extended (I).
TRUNK BODY	* upper body rotates to the right while the lower torso rotates left with the step (I).	* block rotation to left (I).	* facing to the left (M).
LEGS	* begins step with right foot (I).	* long homolateral (right) step forward (I). * weight shift was incomplete (I).	

SKILL: THROW 3

	PREPARATION	THROW	FOLLOW-THROUGH
ARM RIGHT	* downward and backwards to a position behind the head (M). * elbow flexes (M).	* humerus moves forward with elbow at shoulder height (horizontally) (M). * elbow partially extends to point of release (I). * release is early - high beside the head (I).	* arm extends forward until hand is even with the shoulder (i.e., follow-through is arrested) (I) and then moves to the right side, slightly abducted (I).
TRUNK BODY	* rotates slightly to the right (I-M).	* limited block rotation to the left (I).	* continues to rotate to the left (M).
LEGS	* weight on the right foot (M). * feet side by side (laterally) (I).	* contralateral (left) step to the side - placed beside the right foot (I). * weight transfer is complete (I).	* steps around with right foot past the left (M).

SKILL: THROW 4

	PREPARATION	THROW	FOLLOW-THROUGH
ARM RIGHT	* arm circles downward and backward, then the elbow flexes to bring the ball/hand to a position behind the head (M).	* humerus moves horizontally as the shoulders rotate to front facing - almost humeral lag (I-M). * forearm has a delayed lag - does not move forward until the shoulders are facing the front (M). * arm extends to point of release (M).	* arm is mostly extended (I) as it moves across the body at about waist level (M).
TRUNK BODY	* body is facing to the right (M). * head is facing front in the direction of the target (M).	* block rotation (very close to differentiated) (I). * head facing target (M).	* body flexes at the waist/hips (I). * head facing target for most of the follow-through (M).
LEGS	* weight totally on the right foot (M).	* long contralateral (left) step (M). * weight completely transfers to front (left) foot (M).	* right foot comes around to a position slightly in front of the left (M).

APPENDIX M

SKILL PHASE IDENTIFICATION WITHIN OBSERVATION AND FEEDBACK TESTS

Table M1

Percent (Actual) Of Jump Observation Statements Identifying Specific Skill Phases For Each Group

Skill Phase	PK		CK		PCK		CONTROL	
	pre	post	pre	post	pre	post	pre	post
Preparation/ Takeoff	26.61 (29)	32.32 (32)	30.77 (28)	30.60 (56)	32.63 (31)	25.50 (38)	37.50 (33)	28.57 (32)
Flight	33.03 (36)	27.28 (27)	19.78 (18)	40.44 (74)	11.58 (11)	31.54 (47)	9.09 (8)	11.61 (13)
Landing	40.37 (44)	40.40 (40)	49.45 (45)	28.96 (53)	55.79 (53)	42.95 (64)	53.41 (47)	59.82 (67)
Number Of Statements	109	99	91	183	95	149	88	112

Table M2

Percent (Actual) Of Throw Observation Statements Identifying Specific Skill Phases

Skill Phase	PK		CK		PCK		CONTROL	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Preparation	12.62 (13)	11.96 (11)	10.99 (10)	28.03 (44)	14.29 (9)	23.20 (29)	23.46 (19)	15.00 (15)
Force Production	76.70 (79)	75.00 (69)	76.92 (70)	65.61 (103)	65.08 (41)	61.60 (77)	69.14 (56)	76.00 (76)
Follow-Through	10.68 (11)	13.04 (12)	12.09 (11)	6.37 (10)	20.63 (13)	15.20 (19)	7.41 (6)	9.00 (9)
Number Of Statements	103	92	91	157	63	125	81	100

Table M3

Percent (Actual) Of Jump Feedback Statements Identifying Specific Skill Phases

Skill Phase	PK		CK		PCK		CONTROL	
	pre	post	pre	post	pre	post	pre	post
Preparation/ Takeoff	40.98 (25)	33.33 (19)	60.00 (33)	33.65 (35)	37.14 (13)	29.82 (34)	48.21 (27)	36.17 (17)
Flight	22.95 (14)	31.58 (18)	14.55 (8)	55.77 (58)	17.14 (6)	33.33 (38)	17.86 (10)	19.15 (9)
Landing	36.07 (22)	35.09 (20)	25.45 (14)	10.58 (11)	45.71 (16)	36.84 (42)	33.93 (19)	44.68 (21)
Number Of Statements	61	57	55	104	35	114	56	47

Table M4

Percent (Actual)Of Throw Feedback Statements Identifying Specific Skill Phases

Skill Phase	PK		CK		PCK		CONTROL	
	pre	post	pre	post	pre	post	pre	post
Preparation	9.43 (5)	14.06 (9)	28.89 (13)	25.58 (22)	3.57 (1)	23.38 (18)	11.91 (5)	11.76 (6)
Force Production	86.79 (46)	76.56 (49)	66.67 (30)	72.09 (62)	89.29 (25)	66.23 (51)	80.95 (34)	84.31 (43)
Follow-Through	3.77 (2)	9.38 (6)	4.44 (2)	2.33 (2)	7.14 (2)	10.39 (8)	7.14 (3)	3.92 (2)
Number Of Statements	53	64	45	86	28	77	42	51